Exploration Overview 1991

Northwest Territories

MINING, EXPLORATION AND GEOLOGICAL INVESTIGATIONS

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PART 1

EXPLORATION AND MINING OVERVIEW

INTRODUCTION

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HIGHLIGHTS

Continued low prices of base metals and gold during the year contributed to the weakness of exploration and to a general downturn in mining during the year. Finding capital for exploration continues to be a problem in the mining sector and it is particularly felt in frontier areas such as the NWT.

Mining

Closure of Colomac Mine was a low point in NWT mining. Construction of a circa $20 million autoclave to permit environmentally safe processing of refractory ores still remaining in the Con Shear at the NERCO-Con mine, and continued profitable operation of Nanisivik and Polaris zinc-lead mines in the face of low zinc prices augurs well for the future of the NWT industry.

Exploration

Exploration was up slightly over 1990 levels with the increase mainly in the expanded efforts of a few major companies. A number of companies continue to work on what can be termed "advanced exploration", mainly for gold. Major projects include (1) BHP-Utah on the CROWN-ULU claims between the Hood and James Rivers, (2) Homestake Mining Company and Kerr-McGee Corporation on the George Lake iron-formation-hosted gold deposits 50 km south of Bathurst Inlet, (3) Lucky Eagle Mines, Agnico Eagle Mines Ltd. and Hecla Mining Company of Canada Ltd. on the Meadowbank iron-formation-hosted gold deposits 45 km north of Baker Lake, and (4) Asamera Minerals Inc. and Comaplex Minerals Corp. on iron-formation-hosted gold deposits 15 km north of Rankin Inlet. Urangesellschaft continued to explore uranium deposits 50 km west of Baker lake. All these projects included significant expenditures on diamond drilling.

Placer Dome acquired the rights to explore major parts of Noble Peak's and Dejour's mineral land holdings in the Rankin-Ennadai volcanic terrane. Noranda and joint venture partners have spent considerable time and money on large blocks of land on Victoria Island believed favourable for "copperbelt-type" deposits. Noranda has also acquired a large block of land along the Rae River west of Coppermine. Some interest has been shown in base metal deposits in the Archean rocks of the NWT as well in the potential of the Bear Province for Olympic Dam-type deposits, but as yet there has been little money spent in either of these areas.

The most interesting exploration play in years has developed in the central part of the Slave Province, where BHP-Utah, Dia Met and others have acquired huge blocks of ground. Diamond prospecting, which has gone on for years in NWT, appears now to be extensive with work in recent years (and probably this year as well) west of Great Slave Lake, and widespread staking to acquire mineral rights over spot magnetic highs which could be caused by diapirs of mantle derivation. A large "mantle-root" (old Archean rocks that include supracrustals taken down to mantle depths) is inferred under the southern part of the Slave Province (Helmstaedt, this volume) and diapirs that have come through this root may have entrained diamonds.

Diamond exploration gained prominence with Dia Met's announcement that 81 small diamonds had been found in core drilled on their 81 500-ha property near Lac de Gras (76 D) in the Slave Province. The hole was drilled 5 km due north of Pointe de Misère and 5 km northwest of the Lupin winter-road crossing to Lac du Sauvage. A reverse-circulation drill rig was used to obtain a bulk sample from the diamondiferous kimberlite during the winter of 1992.

During the first 10 months of 1991 claim recording was down significantly from the average levels of the past few years, but as a result of the diamond discovery claim staking during November and December pushed ground acquisition to levels not seen since 1978 and 1979. Most of this staking was in NTS 76 D & E and in 86 A. As shown in Graph 1, approximately 515 000 ha of claims were recorded during 1991 in this diamond staking rush, and nearly 800 000 ha in January and February 1992, for a total of about 1.3 million ha (13 000 square km, 5080 square miles). More ground has been staked, but not yet recorded.

Claims were also recorded in the Rae Province of the Keewatin District, in the Bear Province and in the Arctic Islands (Graph 1).

Thirty-four prospecting permits were issued at the end of January 1991 (Graph 2). Copper was the primary target of the 12 Prospecting Permits issued in the Arctic Islands (Minto Arch of the Bear Province on Victoria Island) and gold the major target of most of the 15 prospecting permits issued in the Rae/Hearne Provinces.

On February 1, 1992, 43 Prospecting Permits expired or were relinquished and 22 new ones were issued (Graph 2). Homestake and Comaplex obtained 11 permits in the Rankin-Ennadai belt of the Keewatin (Churchill) where the target is presumed to be gold. R.C. Day obtained a permit on the NWT-Saskatchewan border (north of Stoney Rapids) where the target may be nickel and platinoids in ultramafic rocks near the junction of the Rae and Hearn subprovinces of the Churchill Province. Aber Resources obtained 4 permits on Victoria Island where targets are probably copper in sediments and volcanics. Noranda obtained permits on the Tree River at the Bear-Slave Province boundary and in the southwestern

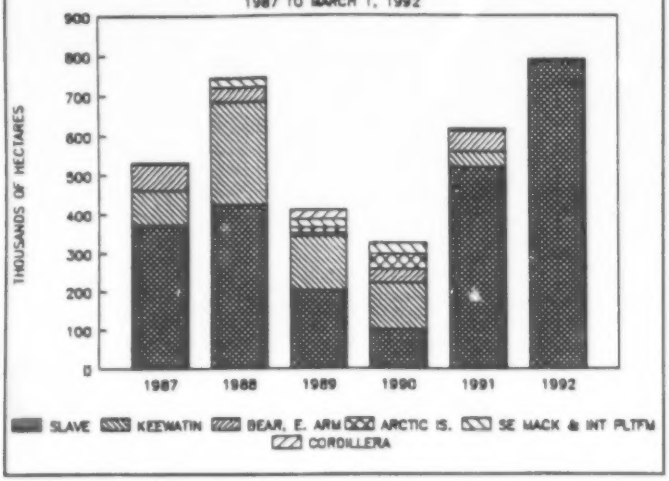
TABLE 1: MINERAL CLAIMS IN THE NWT 1984 to March 1, 1992 (Hectares)

Year	Recorded	Lapsed	Good Standing
1984	240 900	472 323	2 878 225
1985	294 886	468 321	2 704 790
1986	360 361	343 167	2 721 984
1987	552 385	444 856	2 829 503
1988	739 928	451 514	3 117 917
1989	456 987	419 353	3 155 551
1990	355 346	900 400	2 610 497
1991	666 374	480 263	2 796 608
* 1992	784 366	182 437	3 398 526

* 1992 data is current to March 1/92.
Compiled by: Mining Lands Division, NWT Region, DIAND

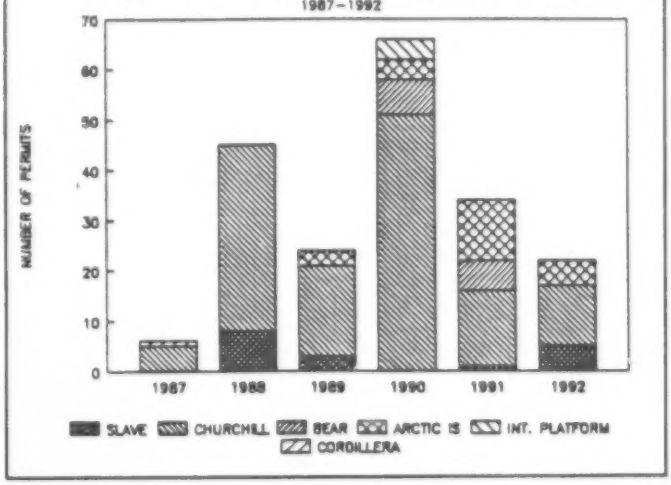
GRAPH 1

STAKING BY GEOLOGICAL AREA
1987 TO MARCH 1, 1992



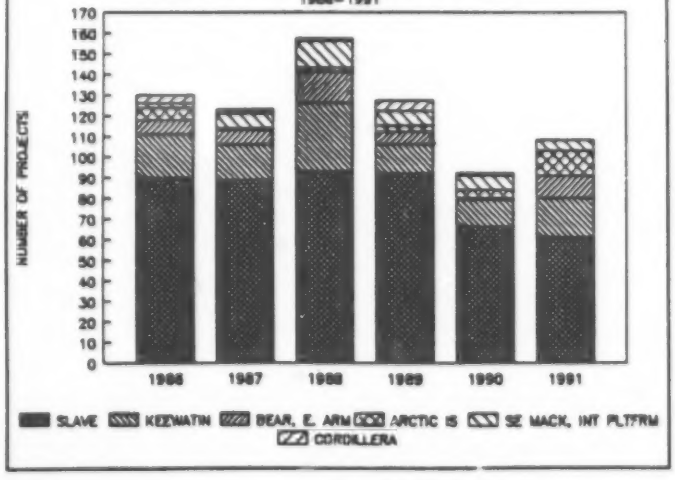
GRAPH 2

PROSPECTING PERMITS BY GEOLOGICAL AREA
1987–1992



GRAPH 3

PROJECTS PER GEOLOGICAL AREA
1986–1991



part of the Borden Peninsula. Targets in both areas may be copper in sediments. Minnova obtained 4 permits around the Hood River #10 deposit in 86 I SW. The target is volcanogenic massive sulphide deposits similar to Hood #10.

A larger number of properties (109) were explored this year than in 1990 (Graph 3), mainly because of significant increases in the Keewatin, Bear Province and Arctic Islands. In other areas fewer properties were explored than in 1990. Some of the increase in exploration in the Keewatin may have been triggered by the expected TFN land-claim settlement, which could have a significant effect on the ease of restaking mineral lands if overlying claims lapse after the settlement has been made. Existing holdings will not be significantly affected by the settlement.

Gold was the main target in the Slave and Hearne Structural Provinces, uranium exploration was confined to the Rae Province, where two properties were also explored for gold. Exploration in the Bear Province and the Arctic Islands was essentially for base metals.

Diamond drilling (Table 2) was mainly for gold, and the 'advanced' exploration projects mentioned previously accounted for the lion's share of this. Drilling around Kiggavik continued to be an important element.

GOVERNMENT GEOSCIENCE WORK IN NWT

A new "Mineral Development Agreement" known as the Mineral Initiative Program (MIP) was signed during the year. This is part of the new Economic Development Agreement for the NWT. Although monies for this program were not available until late in the year, Geological Survey of Canada programs developed as part of the new Mineral Initiatives Program began with interim funding from GSC A-Base, and projects under the Yellowknife NWT Mineral Initiatives Office (MIO) were in progress with bridge funding provided by Government of the NWT. Three mapping projects and reconnaissance for a number of projects to begin in 1992 were undertaken by officers of the Yellowknife MIO office. These activities are described elsewhere in this overview.

NWT GEOLOGY DIVISION ACTIVITIES

Federal government budget tightening continued to reduce the level of activities of the NWT Geology Division. Only two NWT Geology Division mapping crews operated in 1991. V.A. Jackson and a crew of seven mapped approximately three 15' by 30' quadrangles along the northwest edge of the Slave Province northeast of Napaktulik (Takijug) Lake. This work will continue over the next few years as the NWT Geology Division's contribution to the Slave Province NATMAP effort. It will complete mapping at 1:50 000 scale of the northwestern part of the Slave Province. This work was coordinated with 1:20 000-scale mapping in the Hanikahimajuk (Amooga Booga) Lake area (86 I/2) by a MIO crew under J. Gebert.

J.A. Brophy assisted by various NWT Geology Division staff mapped and sampled the Wheeler Lake turbidite domain which contains an abundance of auriferous iron formation. Structural geochemical and stratigraphic studies are in progress to unravel the setting and genesis of these gold showings. This work will be coordinated with a broader-scale project to study the iron-formation-hosted gold deposits of the NWT under a joint Geological Survey of Canada (MIP)-NWT Geology Division project.

TABLE 2: SUMMARY of DIAMOND DRILLING in the NWT, 1987-1991[1]

	1987	1988	1989	1990	1991
BY DISTRICT					
Franklin (Arctic Islands)	28 504.0	25 988.1	19 758.80	6 415	27 662
Keewatin	32 867.6	38 107.9	7 996.81	12 068	20 160
Mackenzie	128 868.5	121 333.6	133 166.13	170 195	136 052
BY GEOLOGICAL AREA					
Slave	108 716.8	112 943.2	131 784.90	164 574	112 102
Bear	3 169.2	8 390.2	0.00	0	23 950
Churchill	46 964.5	Rae: 9 516.9	5 887.10	2 625	11 630
		Hearne: 28 556.4	2 109.20	9 443	8 530
Cordillera	244.5	0.0	0.00	0	0
Interior Platform	15 348.2	15 466.8	1 381.02	5 621	0
Arctic Islands	15 979.0	10 521.8	19 758.80	6 415	27 662
BY COMMODITY					
Uranium	8 664.1	9 516.9	5 887.10	5 390	10 900
Base Metals	43 852.2	53 157.5	27 605.90	17 804	26 162
Precious Metals (Au mainly)	133 164.7	113 524.4	134 230.64	164 346	146 536
Tungsten & Rare Metals	0.0	3 519.5	0.00	1 138	0
Platinum Group Elements	4 559.1	5 711.3	0.00	0	0
Diamond	0.0	0.0	0.00	0	276
SURFACE DRILLING	140 101.1	140 393.1	79 762.58	113 933	110 527
UNDERGROUND DRILLING	50 138.9	45 036.5	81 158.16	74 745	73 347
TOTAL DRILLING	190 240.1	185 429.6	160 921.74	188 678	183 874

[1] data recorded in metres

Detailed stratigraphic analysis was undertaken by W.A. Padgham (assisted by numerous others) of the Raquette Lake Formation on the east side of the Yellowknife Supracrustal Basin to settle an ongoing controversy over the relationship of that formation to the Cameron River and Beaulieu River volcanic belts. The latter is the site of numerous silver-rich volcanogenic massive sulphide deposits.

Contract mapping was begun by H. Helmstaedt's (Queen's Univ.) student, K. MacLachlan, in the Yellowknife volcanic belt. Ms. MacLachlan and an assistant began detailed mapping of the multiple-dyke complex near the base of the Kam Group, host to Yellowknife gold deposits. S.A. Bowring (Massachusetts Institute of Technology) and various visiting staff from Australian National University and MIT continued contract mapping around the site of the oldest rocks in the world on the Acasta River (86 G/2,7). Numerous geochronology samples were collected in the Yellowknife Basin as part of a joint MIT/NWT Geology Division project to improve our knowledge of the structure and tectonics of this gold-rich basin. A contract was let to A. Aspler to study volcanogenic hot-spring-related gold deposition associated with volcanism in Proterozoic rocks overlying the Rankin-Ennadai volcanic belt of the Keewatin. D. Kerr, also under contract, completed surficial mapping in the Hepburn Island map area (76 M) and produced a 1:250 000 compilation thereof. Susan Schaan and one assistant mapped parts of 75 M/5 to determine the extent (if any) of Beniah Lake Formation stable-shelf sediments (quartzarenites) and to improve knowledge of this area last studied during reconnaissance canoe work in the 1940's. This work will complement a MIO project to map the whole of the Camsell Lake supracrustal belt at 1:50 000 (see Johnstone's report elsewhere in this Overview). Ms. Schaan's work was supervised by Prof. W.K. Fyson of Ottawa Univ., who also provided advice and assistance to a number of other NWT Geology Division and MIO projects.

CANADA-NORTHWEST TERRITORIES MINERAL INITIATIVES

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The Canada-NWT Economic Development Framework Agreement was signed in February, 1991. Under the Agreement, DIAND and the GNWT will cooperate in the development and delivery of a number of Economic Development Initiatives.

Four of these Initiatives fall under the title of the Mineral Initiatives. The four Initiatives have a total budget of $8.2 million over the term of the Agreement, 1991 - 1996, divided as follows:

I	Geoscience Initiative	$7,500,000
II	Technology Initiative	$200,000
III	Information Initiative	$200,000
IV	Prospectors Initiative	$300,000

In addition to the budgetary controls for each Initiative, DIAND and the GNWT have established regional funding targets for each Initiative. The budget of each Initiative is distributed between the various administrative regions of the NWT.

A Committee has been established to manage the four Initiatives. The Mineral Management Committee members are:

George Patterson: Energy, Mines & Petroleum Resources
Bill Padgham: NWT Geology Division, DIAND
Mike McMullen: Mineral Policy Sector, EMR Canada
John Colford: Economic Development & Tourism, GNWT

Tom Hoeffer, General Manager of the Chamber of Mines, is an advisory member of the Committee.

The Department of Energy, Mines and Petroleum Resources (EM&PR) is the Implementing Party for the Initiatives, responsible for the delivery of the projects under each Initiative. EM&PR has established a Mineral Initiatives Office to coordinate the delivery of the Initiatives. In addition an Advisory Committee will oversee the development and delivery of projects under each Initiative. Projects under the Geoscience Initiative are shown in Figure 1.

For more information on any of the four Mineral Initiatives, contact:

EM&PR/DIAND Mineral Initiatives Office
Energy, Mines and Petroleum Resources
5111 50th Street, Nova Building
Government of the Northwest Territories
Box 1320
Yellowknife, NWT, X1A 2L9
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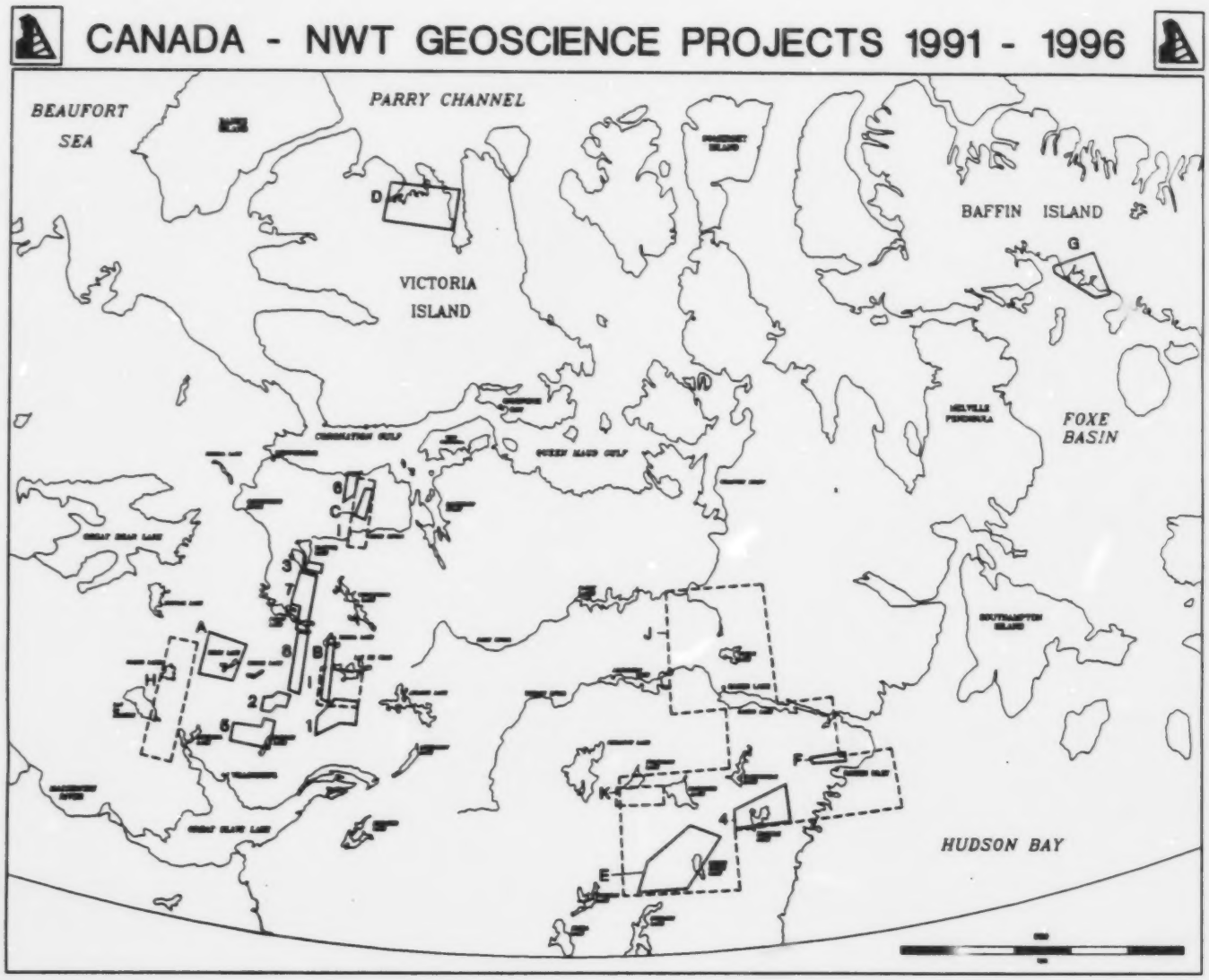

ENERGY, MINES AND PETROLEUM RESOURCES

1	CAMSELL LAKE	1991 - 1995
2	SQUALUS LAKE	1991
3	AMOOGABOOGA LAKE	1991
4	KAMINAK LAKE	1991 - 1996
5	FISHING LAKE	1991 - 1996
6	ANIALIK RIVER	1991 - 1996
7	POINT LAKE	1991 - 1996
8	WINTER LAKE	1991 - 1995
NWT - WIDE	COMPUTERIZED MINERAL SHOWINGS DATABASE	1992 - 1996

GEOLOGICAL SURVEY OF CANADA CONTINENTAL GEOSCIENCE

A	INDIN - SOUTH WOPMAY	1991 - 1996
B	COURAGEOUS LAKE	1991 - 1996
C	HIGH LAKE	1991 - 1996
D	MINTO INLIER	1991 - 1995
E	HURWITZ - KAMINAK	1991 - 1995
F	GIBSON - MELIADINE	1991 - 1996
G	EQE BAY	1991 - 1995

GEOLOGICAL SURVEY OF CANADA MINERAL RESOURCES

H	GREAT BEAR MAGMATIC ZONE	1991 - 1996
I	HIGH LAKE/COURAGEOUS LAKE	1991 - 1996
J	KEEWATIN METALLOGENY	1991 - 1996
K	REDBED COPPER	1992 - 1994
NWT - WIDE	KIMBERLITES	1991 - 1994
NWT - WIDE	GOLD IN IRON FORMATION	1991 - 1996
NWT - WIDE	MINERAL RESOURCES MAP	1991 - 1996

FIGURE 1: Canada-NWT Geoscience Projects 1991-1996.

OPERATING MINES

Carol Ellis
NWT Geology Division, DIAND

Five gold mines and two lead-zinc mines operated in the Northwest Territories during 1991 (Fig. 2). Production estimates for the mines are given in Table 3. The value of metals mined in 1991 is estimated to be $480 million (Table 4), down from just over $600 million in 1990. This decrease is due to lower prices for the metals, in particular lead and zinc, and slightly decreased production of both lead and zinc.

For the second year in a row NERCO-Con Mine (85 J/8) set a new production record: 3825 kg of gold. Production was from various areas of the mine between the 2300 and 5900-foot levels. Ore-definition drilling totalling 60 000 m was completed during the year. Underground exploration was done between the 2600 and 2900-foot levels north of the B3 winze, between the 2300 and 2700-foot levels south of the B3 winze, and between the 3500 and 5900-foot levels in the vicinity of the Robertson Shaft. New stations are being cut off the Robertson shaft at the 3100, 3300 and 3700-foot levels. Drifts on the 3100-foot level will connect the Robertson shaft and B3 winze. An access ramp to link the 2600, 2750, 2900 and 3100-foot levels is being developed midway between the Robertson shaft and the B3 winze.

An autoclave is being added to the NERCO-Con mill at a cost $19 million. It will be installed in early 1992 and is expected to be operational by mid 1992. The autoclave will treat refractory ore from the upper levels of the Campbell Shear Zone as well as arsenic sludges and calcine wastes.

Most of the production from Giant Mine (85 J/9) was from underground, with only 10 000 t of ore mined from surface; the Brock vein, B2 and B4 pits. At year end 18 300 m of underground development drilling had been completed. The lower B area is being developed between the 1650 and 1800-foot levels. A review of mining methods was done for areas not currently economic, and a long-hole stope is planned for the mid C area.

In July, Royal Oak Mines Inc. was formed from the amalgamation of Royal Oak Resources, Giant Yellowknife Mines, Pamour, Pamorex Minerals and Akaitcho Yellowknife Gold Mines. In September Royal Oak Mines announced that it had paid off all long-term debt, which had totalled $19 million.

At Treminco Resources' Ptarmigan property (85 J/9), production was from the 400-foot level of the C-vein and the 450, 600 and 750-foot levels of the Ptarmigan Mine. Ptarmigan Mine has been de-watered to the 900-foot level and the old workings below the 750-foot level are being rehabilitated. Treminco dropped its option on the Crestaurum property early in the year because of low gold prices.

MINE	OWNER	WORKFORCE
NERCO-Con Mine	Nerco Minerals Inc.	395
Giant Mine	Royal Oak Mines Inc.	325
Ptarmigan Mine	Treminco Resources Ltd.	30
Colomac Mine	Northwest Gold Corp.	closed
Lupin Mine	Echo Bay Mines Ltd.	350
Polaris Mine	Cominco Ltd.	250
Nanisivik Mine	Conwest Exploration Ltd.	215

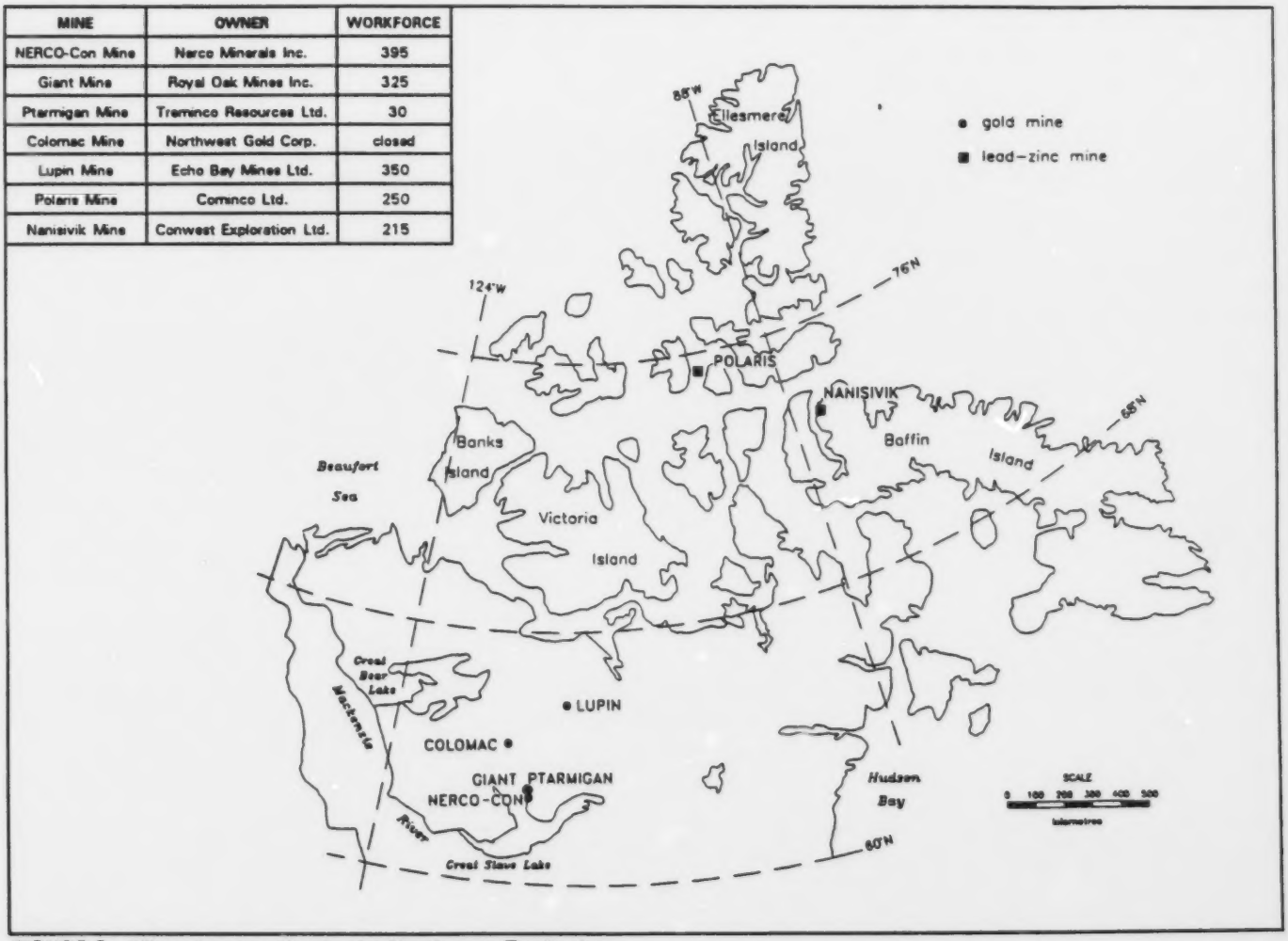

FIGURE 2: Mines in operation in the Northwest Territories.

TABLE 3: NWT MINE PRODUCTION

MINE	COMMODITIES	1990 PRODUCTION[1]		RESERVES (Dec. 31, 1990)		1991 ESTIMATES[2]	
		TONNES MILLED	PRODUCTION	TONNES	GRADE	TONNES MILLED	PRODUCTION
NERCO-Con	gold	302 090	3640 kg Au	3 110 000	10.29 g/t	332 000	3825 kg Au
Giant	gold	350 000 mine	3010 kg Au	787 430	10.65 g/t	386 000	3185 kg Au
		695 000 tails	640 kg Au			-- [3]	-- [3]
Ptarmigan[4]	gold	57 000	560 kg Au	147 000	10.97 g/t	52 500	480 kg Au
Colomac	gold	1 310 000	2130 kg Au	21 600 000	1.89 g/t	1 120 000	2380 kg Au
Lupin	gold	628 680	6070 kg Au	4 042 000	10.63 g/t	660 000	6785 kg Au
Nanisivik	zinc lead silver	716 400	56 200 t Zn 1400 t Pb 18 100 kg Ag	2 681 000	8.5 % Zn 0.3 % Pb 40 g/t Ag	705 000	55 210 t Zn 2190 t Pb 17 230 kg Ag
Polaris	zinc lead	1 017 200	142 200 t Zn 37 700 t Pb	11 795 000	14.1 % Zn 3.8 % Pb	1 075 000	130 300 t Zn 31 220 t Pb

[1]: based on company annual and quarterly reports and form 10-K.
[2]: estimates based on monthly progress reports submitted to Mines Inspection Office of GNWT.
[3]: tailings re-treatment plant did not operate in 1991.
[4]: production figures given for Ptarmigan Mine are for Treminco Resources fiscal year August 1 to July 31.

TABLE 4: ESTIMATED VALUE OF METAL PRODUCTION FROM THE NWT, 1986 to 1991

Year	gold (kg)	silver (kg)	lead (kt)	zinc (kt)	value ($ million)
1986	12 233	27 899	138	417	$780
1987	12 280	25 218	151	479	$843
1988	11 834	24 234	65	292	$560
1989	13 685	20 050	34	195	$598
1990	15 395	21 172	36	196	$606
1991	16 220	20 260	33	185	$480

Operations at Colomac Mine (86 B/6) were suspended at the end of June, and the mine is now on care and maintenance status. Before Colomac Mine could reopen, the price for gold must be at least US $425/oz and its debt must be restructured. Mill feed and recovery rates steadily increased during 1991. Ore milled increased from 5170 t/day during the last quarter of 1990 to 6800 t/day during the second quarter of 1991, but never attained the 10 000-t design capacity of the mill. The recovery rate increased by 1% each quarter from 92% recovery during the fourth quarter of 1990 to 94% recovery during the second quarter of 1991. Since start up in May 1990, 4510 kg of gold has been recovered from 2.4 Mt of ore with an average grade of 2.02 g/t.

Production at Lupin Mine (76 E/14) was from three zones: 55% from between the 410 and 570-m levels and the 170 to 190-m levels of the Centre Zone, 40% from the 330 to 410-m levels and 490 to 570-m levels of the West Zone, and about 5% from the East Zone above the 330-m level. During the year 10 500 m of exploration drilling and 6500 m of ore definition drilling was completed. As a result of the backfill program begun in 1990, a sill in the Centre Zone between the 170 and 190-m levels was mined.

Development at Lupin Mine included drifting on the 670, 710 and 1130-m levels of the Centre Zone and development between the 510 and 650-m levels of the East Zone near the south nose. In the West Zone, development was completed on the 430 to 470-m levels but continues on the 490-m level and the 610 to 650-m levels. Ramp development continued as the ramp was driven to the 1050-m level from the 890-m level. An access ramp to a planned crusher room being developed on the 1130-m level was cut this year. The crusher room will be completed in 1992.

At Nanisivik Mine (48 C/1) the main lens contributed 30% of the mill feed this year; the remainder came from satellite zones; Shale Hill, Eastern Lower Lens, Central Lower Lens, and North Zone. During the year 11 000 m of underground drilling and 6500 m of surface drilling was completed on the property. A ramp was begun to access the lower level of Shale Hill.

At Polaris mine (68 H/8) production was mainly from primary stoping in the Central Keel Zone and pillar recovery in the South Keel Zone; less than 10% of the mill feed was from pillar recovery in the Panhandle Zone.

SLAVE STRUCTURAL PROVINCE

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(Exploration is for gold unless otherwise noted.)

HIGH LAKE & ANIALIK VOLCANIC BELTS

BHP-Utah Mines Ltd. continued to explore the central part of the High Lake Belt on a large land package which includes the DEN-FIDO group optioned from Aber Resources. The focus was on the ULU property at the western margin of the belt (76 L/14,15) *(13 in Fig. 3)*. Mapping at a 1:5000 scale was completed over most of the property. Peripheral parts were covered at 1:10 000. Surveys included 32.1 line km of Mag-VLF, 11.0 line km of IP and 8 line km of soil sampling. Three trenches totalling 45 m were excavated. A total of 21 000 m was drilled in 42 holes to delineate the Flood Zone gold deposit and to test a number of peripheral targets. The deposit comprises a fracture-controlled quartz-vein and silicified system with a strike length of about 400 m hosted by mafic metavolcanic rocks. It lies within a tightly folded, north-trending, 5-km-long, moderately to steeply north plunging anticlinal structure that folds a sequence of interlayered basalt, greywacke and gabbro sills. Significant mineralization has been intersected to a depth of 600 m.

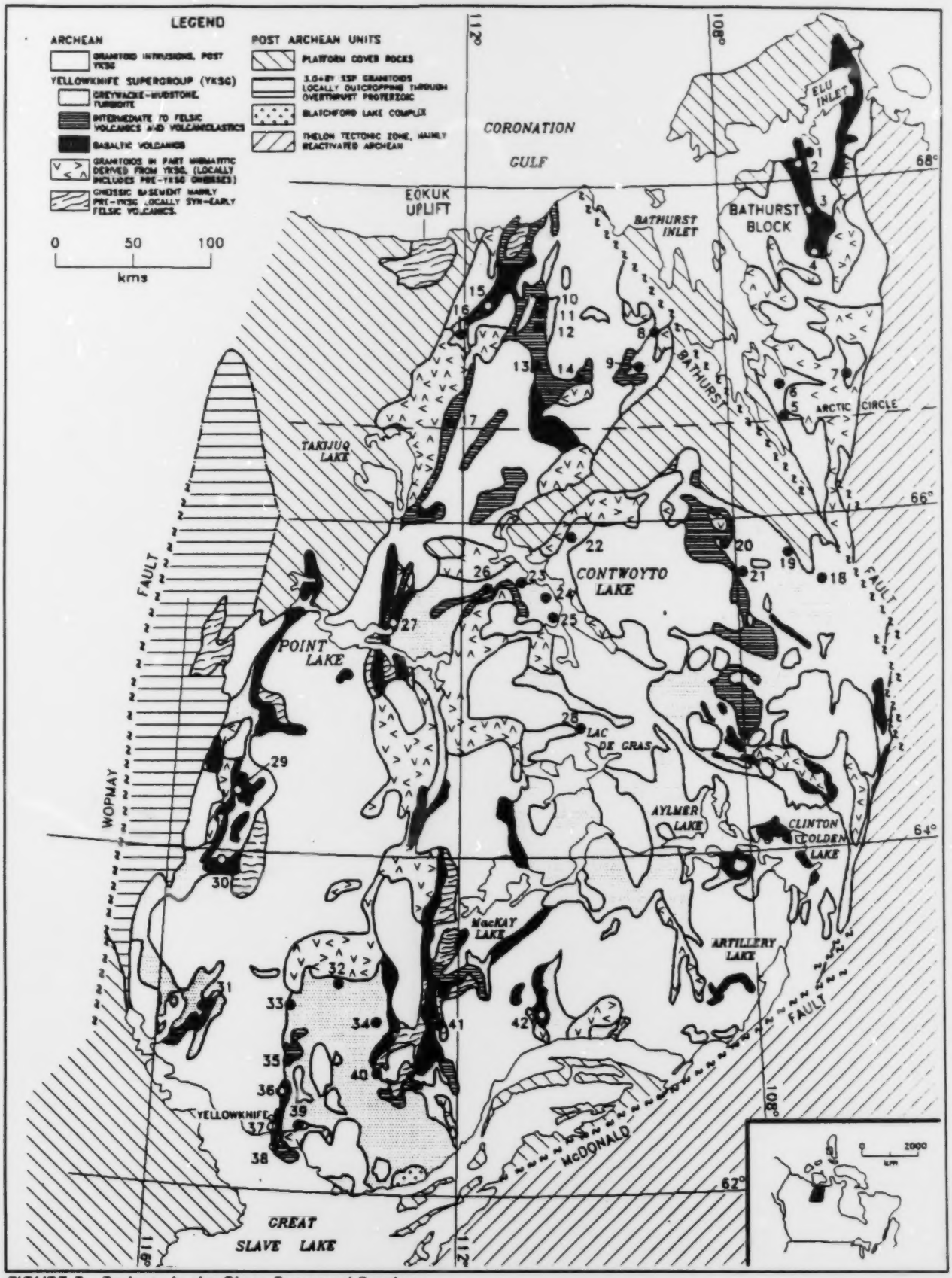

FIGURE 3: Projects in the Slave Structural Province.

On the adjacent CROWN and DEN-FIDO properties (76 L/15) *{13 in Fig. 3}*, BHP-Utah completed 1:2000-scale mapping on the main areas of interest and 1:10 000-scale mapping elsewhere. On the CROWN property, 5 line km of Mag-VLF and HLEM geophysical surveying was done, and on DEN-FIDO, 14 line km of Mag-VLF was completed. On CROWN, a polymetallic zone in mafic metavolcanics was tested with 484 m in two holes, and on DEN-FIDO, ULU-style mineralization was tested with five holes totalling 403 m. To the south of these properties, 1:5000-scale mapping on PULSE (76 L/10,14,15) and 1:10 000-scale mapping and prospecting on KINDLE (76 L/10,15) and SINGLETON (76 L/9,10) were done.

On the BAMAKO-PARIS claims (76 M/2,3) *{12 in Fig. 3}*, BHP-Utah prospected and mapped at a 1:2500 scale, and completed 25 line km of Mag-VLF surveys. On the BRAVO claim (76 M/2), 1:10 000-scale mapping was completed.

On the HOTEL claims (76 L/16) *{14 in Fig. 3}*, BHP-Utah did 1:10 000-scale mapping, prospecting, and a 31-line-km Mag-VLF survey. A small soil-sampling survey was done over a gold showing in brecciated po-py zones along an interflow contact. The target was further tested with 325 m of drilling in seven holes. On the nearby SPARK claim, 1:10 000-scale mapping, prospecting, and a small soil-sampling survey were carried out.

In the northern High Lake Belt *{10 in Fig. 3}*, BHP-Utah completed 1:10 000-scale mapping on the CAIRO & ROMA (76 M/7) and CYGNET (76 M/10) properties. On ROMA, 1:2500-scale mapping, Mag-VLF, HLEM and soil sampling were conducted on a 22-line-km grid. Ten holes totalling 465 m were drilled to test a gold-bearing quartz vein. On CYGNET, 1:2000-scale mapping and a Mag-VLF survey were completed on a 22-line-km grid to evaluate narrow, arsenopyrite-bearing shears in felsic to intermediate metavolcanics.

Kennco Explorations (Canada) Limited conducted a brief geophysical and geochemical survey of their massive sulphide deposit on the HIGH LAKE claims at High Lake (76 M/7) *{11 in Fig. 3}*.

BHP-Utah Mines Ltd. completed 1:10 000-scale mapping on its ARNICA claims (76 M/5) *{15 in Fig. 3}* in the Anialik Belt. This mapping was extended onto parts of surrounding PROSPECTING PERMIT 1181. Prospecting of the remainder of the permit was completed. In the southern Anialik, BHP-Utah did 1:31 680-scale mapping and prospecting on PROSPECTING PERMIT 1285 (86 P/1) *{16 in Fig. 3}*.

HOPE BAY VOLCANIC BELT

GSA Management Ltd. and **Goldcorp Investments Ltd.** drilled several holes along the northeast trend of the Wombat or Granite gold prospect at Roberts Lake (77 A/3) *{1 in Fig. 3}*).

BHP-Utah Mines Ltd. conducted reconnaissance in the Hope Bay Volcanic Belt and staked the BOSTON (76 O/9) *{4 in Fig. 3}*, SANTIAGO & MADRID (77 A/3) *{2 in Fig. 3}* and HAVANNA (76 O/16) *{3 in Fig. 3}* claims. Prospecting and 1:5000-scale mapping were conducted on BOSTON and KAMIK (76 O/15). Twenty-five line km of soil or Mag-VLF surveys were completed on BOSTON, and a 14-line-km Mag-VLF survey on KAMIK.

OTHER PROJECTS IN THE NORTH SLAVE

Cogema Canada Ltd. explored for gold in the Torp Lake metasedimentary belt, adding the LUI (76 K/14) *{9 in Fig. 3}* and MARC (76 N/3) *{8 in Fig. 3}* claims to other properties previously staked in the area, namely the JOE claim (76 K/14) and the [illegible]Y-LACH group (76 N/5,6).

BHP-Utah Mines Ltd. prospected the TAK claim (86 I/9) *{17 in Fig. 3}* in the Hood River Belt.

Cogema Canada Ltd. explored several claim blocks in the Tinney Hills-Hiukitak River area for amphibolitic iron-formation-hosted gold deposits (76 J/11,14-16) *{5,6 & 7 in Fig. 3}*.

BACK RIVER - GEORGE LAKE AREA

George Lake Joint Venture, comprising Homestake Mineral Development Company (73.75%) and Kerr-McGee Corporation (26.25%), continued to work on gold prospects in oxide- and silicate-facies iron formations at George Lake (76 G/11-14) *{19 in Fig. 3}*. In late 1990 Homestake assumed Operator status from Trigg Woollett Olson Consulting Ltd. for certain key claims in the George Lake Joint Venture project. The 1991 program continued intensive exploration on the property, directed primarily at infill drilling to increase the confidence of the inferred geological resource on the Locale 1 and Locale 2 deposits. A total of 28 690 m were drilled in 140 holes during the program which extended from early April to mid-July. Exploration activities also included trenching, minor ground geophysical surveys, structural and geological mapping and aerial photography.

The Back River Joint Venture, comprising Homestake Mining Company, Kerr-McGee Corporation and the Mac Lab Group, did geophysical surveys and drilled selected targets at Boot Lake (76 G/9) *{18 in Fig. 3}*. They also mapped, prospected and sampled their claims. The projects were managed by Trigg Woollett Olsen Consulting Ltd.

Echo Bay Mines Ltd. drilled for Bathurst Norsemines-style massive-sulphide mineralization on the PXD-FEG-BEB group (76 F/16, G/13) *{20 in Fig. 3}*, drilled for iron-formation-hosted gold on the BUCK-NUTS group (76 G/12) *{21 in Fig. 3}*, and reconnoitred other properties in the Beechey Lake-Back River region.

RUSSEL LAKE-INDIN LAKE AREA

Northwest Gold Corporation completed winter geophysics and drilling on the Colomac Mine lease and on adjacent ground optioned from Petromet and Comaplex (ED-CDC group). This work resulted in the discovery of Zone 24 on the ED 1 claim, which was stripped, sampled and drilled in the summer. Additional work included: mapping at 1:4800, staking and reconnaissance mapping of the NWG 1-6 group, staking of the KNOB 1-2 claims, linecutting on NWG 2, and a two-channel VLF survey on CARJON 3 and NWG 2. All properties are in 86 B/6 *{29 in Fig. 3}*.

Robert Curtis prospected the CHARLES and MARY claims at Wijinnedi Lake (85 O/14) *{30 in Fig. 3}* and established the presence of silicate-rich iron formation carrying up to 62 ppb gold. He also staked additional claims in the same area.

Fortune Minerals Ltd. prospected, sampled and mapped the ROBIN-NATASHA-YELLER-IRON group along the Bousso River (85 O/3) *{31 in Fig. 3}* in the Russel Lake region. On the ROBIN claims, Lupin-style gold mineralization was identified in a volcanic fragmental host unit. Chip samples returned an average grade of 7.48 g/t Au across 2.8 m. Grab samples returned as much as 33.2 g/t Au. Sampling of a nearby zone of massive sulphides at the transition between coarse intermediate fragmental rocks and greywacke sediments returned up to 1320 ppb gold, 3311 ppm zinc and 1946 ppm copper.

CONTWOYTO-ITCHEN-POINT LAKES AREA

(Exploration was for Lupin-type gold deposits.)

Joint venture partners **Cominco Ltd.**, operator, and **Cogema Canada Ltée** explored the COCO claims (76 E/16) *{22 in Fig. 3}* with prospecting and 60 line km of magnetometer and HLEM geophysical surveys. Conductors were tested by 915 m of drilling in 10 holes.

Cominco Ltd. drilled 10 holes (1200 m) to test the LST claim (76 E/12) *{26 in Fig. 3}*. Drilling intersected narrow, geochemically anomalous sulphide-rich iron formations.

Echo Bay Mines Ltd. continued exploration of their Lupin Mine leases, the adjacent PXD 2 claim, and the FIN claim (76 E/11,14) *{23 in Fig. 3}*. On the leases and PXD 2 claim, a 200-line-km HLEM and magnetometer survey was completed to finish a 3-year program of geophysics to help define iron formations. Mapping, sampling and prospecting together with 6200 m of drilling in 65 holes were also completed. On the FIN claim, 50 line km of magnetometer and HLEM surveys were completed.

Cogema Canada Ltée established 18 line km of grid on the AU claims (76 E/10,11) *{24 in Fig. 3}* for control of geological mapping, sampling, magnetometer and VLF-EM geophysical surveys. Cogema also prospected the western part of the Gossan Lake property and anticipate further geophysical surveys and drilling in 1992.

Contwoyto Goldfields Ltd. contracted Covello, Bryan and Associates of Yellowknife to complete magnetic, VLF-EM and HLEM surveys of a 25-line-km grid on the IF 3 claim and to map and sample the IF 4 claim (76 E/10) *{25 in Fig. 3}*.

Royal Oak Mines Inc. explored the P claims (86 H/6,7) *{27 in Fig. 3}* erecting 2 grids for control of geologic mapping and completing 60 line km of VLF-EM and magnetometer geophysical surveys.

Minnova Inc. announced an agreement with **Falconbridge Ltd.** to buy the Izok Lake (86 H) and Gondor (76 E) properties. Minnova plans 20 000 m of drilling in 1992 to define open pit reserves at Izok.

LAC DE GRAS

(Exploration was for diamonds.)

In the Exeter Lake area **Dia Met Minerals Ltd.** and joint-venture partners **BHP-Utah Mines Ltd.** contracted CF Minerals of Kelowna to conduct diamond-indicator mineralogical sampling of till and eskers on claims A, B, C, D, E, F, T, M and W (76 D/8,9,10,11, C/5,12). A total of 2400 heavy-mineral samples were processed by CF Minerals. Airborne and ground geophysics were also completed. Results confirm nearby sources of kimberlitic material, but no firm indication as to the potential size of the kimberlite. One anomaly was tested by drilling *{28 in Fig. 3}*. Drill hole PL 91-1 intersected kimberlite from 137 m to the end of the hole at 276 m. A 59 kg sample of the kimberlite yielded 81 small diamonds, all measuring less than 2 mm in diameter. Some of the diamonds are gem quality. Following this announcement a staking rush commenced. Additional claims, the GO and ED comprising 95 110 ha, were staked by BHP-Utah Mines Ltd. to adjoin the claim block.

Monopros Ltd. also conducted sampling of eskers in 76 D *{28 in Fig. 3}*.

INDIAN MOUNTAIN LAKE

BHP-Utah Mines Ltd. prospected the COTTONGRASS claims for base metals (75 M/2) *{42 in Fig. 3}*.

CAMERON-BEAULIEU RIVERS VOLCANIC BELT

Nanisivik Mines Ltd. drilled one hole at Sunrise Lake on the SHEET claim (85 I/16) *{41 in Fig. 3}* to test for polymetallic massive sulphides adjacent to the Sunrise deposit of Aber Resources Ltd. and Hemisphere Development Corp.

Nerco Minerals Inc. mapped and sampled to explore for gold on the VIC claims (85 I/11,14) *{40 in Fig. 3}*, which cover Cameron volcanics as well as gneisses and granites of the Sleepy Dragon Complex.

YELLOWKNIFE TURBIDITE BASIN

Knut Rasmussen reports that a 1500-t bulk sample mined in 1990 from the DAF deposit (85 I/14) *{34 in Fig. 3}* was trucked on the ice road from Burnt Island to Treminco's Ptarmigan mill for processing. The grade of the ore was 19 g/t gold.

In November 1991 **Athabasks Gold Resources Ltd.** purchased Chevron Minerals Ltd.'s interest in the Nicholas Lake deposit. More than 16 000 m of drilling has identified a preliminary reserve of 429 000 t grading 15.78 g/t Au. The current $800,000 exploration program, financed by Royal Oak Mines, is designed to test mineralized zones off the Main zone. The program includes reconnaissance geological mapping of most of the property, the PIG, NIC, SAINT and BUSH claims (85 P/4,5) *{32 in Fig. 3}*, at 1:10 000 scale and detailed geological mapping over several areas of interest. Grids have been cut on these areas of interest and prospecting and geophysical surveys including magnetometer, VLF-EM and IP have been completed. New targets have been tested by 3000 m of drilling; these include the Nicholas East Zone, the V.G. and MacAsquill showings.

Treminco Resources Ltd. continued to explore their mine properties, the Tom and Ptarmigan (85 J/9) *{39 in Fig. 3}*.

YELLOWKNIFE VOLCANIC BELT

Treminco Resources Ltd. and **DIW Geological Consultants Ltd.** mapped, prospected and sampled the KAM claims (85 O/1) *{33 in Fig. 3}*.

Ger-Mac Exploration Ltd. collared a new portal on the MON property (85 J/16) *{35 in Fig. 3}* and drifted 70 m to intersect the main vein, which was explored by drilling, 63 m of drifting and two 10-m raises. A 550-t ore sample was mined and Ger-Mac plan to bring a small mill to site this winter to process the ore. A reserve of 7000 t with a mineable grade of 13.3 g/t Au is reported.

Royal Oak Mines Inc. compiled information for an evaluation of the North Belt and conducted prospecting, sampling and line cutting to define drill targets. Targets include a polymetallic massive-sulphide deposit (85 J/8) *{36 in Fig. 3}* on the G claims at Homer Lake.

Nerco Minerals Inc. continued exploration of their mine leases (85 J/8) *{37 in Fig. 3}*. Surface work included mapping and lithogeochemical sampling of the TAN and KEMEX claims and drilling three holes for 1200 m at Kam Point to test the extension of the Campbell Shear, one 300-m hole at Back Bay on the NKANA claims and two holes for 900 m at Fault Lake on the AYE claims, where another 2 holes for 700 m are planned before year end. The C16 Shear was explored by 600 m of drilling in 6 holes.

On the MARLIN claims (85 J/8) *{38 in Fig. 3}* **Golden Marlin Resources Ltd.** and joint venture partner **CAMECO** drilled 5 holes for 775 m to follow up an intersection of 23 g/t Au obtained in hole N90-7 completed last winter, and also to test nearby IP anomalies and structures inferred from seismic and magnetic surveys. Drilling intersected a mineralised structure over a 1-km strike, however gold values were low. Drilling intersected a second mineralised structure with quartz veins and several percent coarse sulphides assaying up to 1.1 g/t Au. CAMECO subsequently terminated the joint venture. Golden Marlin also completed 10 km of detailed IP and 540 m of drilling on the HOPE claims to earn a 50% interest with joint-venture partner Rayrock Yellowknife Resources Inc.

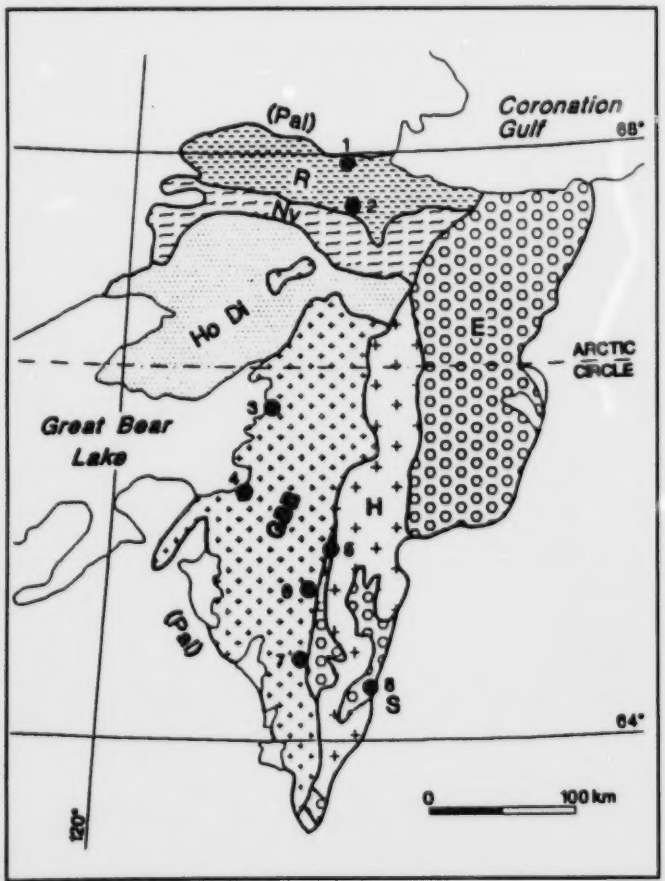

FIGURE 4: Projects in the Bear Structural Province.

BEAR STRUCTURAL PROVINCE

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Cominco Ltd. completed prospecting, mapping and soil sampling to evaluate the base-metal potential of Proterozoic sediments on PROSPECTING PERMITS 1246-1247 in the Robb Lake area (86 F/8) *{5 in Fig. 4}* and PROSPECTING PERMIT 1244 in the Wopmay Lake area (86 F/2) *{6 in Fig. 4}*. Geological, geophysical and geochemical surveys assessed the base-metal potential of the NOR-SP-A1 group at Norris Lake (86 B/5) *{8 in Fig. 4}*. Additional claim staking (CU 1-20) was completed in the Coppermine River area (86 O/12) *{2 in Fig. 4}*. The claims adjoin the CPR 0-8 claims (86 O/11), acquired in 1990, and cover Coronation Sills and flanking sandstone, siltstone and shale of the Hadrynian Rae Group.

Aber Resources Ltd. mapped and sampled Proterozoic sediments on the DV claims at DeVries Lake (86 C/7) *{7 in Fig. 4}*, where stratabound copper showings are associated with anomalous concentrations of gold and tungsten. Uranium, molybdenum, cobalt and niobium showings have also been identified. In addition, Aber completed mapping and trenching on the POINT claims in the Balachey Lake area (86 F/12) *{4 in Fig. 4}*, where encouraging copper and gold assays were obtained from previously reported uranium showings hosted in breccia zones of the Balachey Pluton.

Noranda Exploration Co. Ltd. mapped, prospected and did geochemical surveying on the MAT 1-24 claims (86 O/13,14, N/15,16) *{1 in Fig. 4}*. As well, reconnaissance exploration in

MAIN GEOLOGICAL DIVISIONS

(PAL) PALEOZOIC COVER

BEAR STRUCTURAL PROVINCE
PROTEROZOIC

HADRYNIAN

R RAE GROUP AND CORONATION SILLS

NEOHELIKIAN

Ny COPPERMINE RIVER GROUP: BASALT, SANDSTONE, SILTSTONE

PALEOHELIKIAN

Ho Di DISMAL LAKES GROUP: DOLOMITE OVERLYING RED MUDSTONE, SANDSTONE, AND BLACK SHALE

HORNBY BAY GROUP: SANDSTONE, SILTSTONE, SHALE, DOLOMITE, AND CONGLOMERATE

APHEBIAN

GBB GREAT BEAR VOLCANO - PLUTONIC COMPLEX: INCLUDES THE McTAVISH VOLCANICS SUPERGROUP AND PLUTONS OF THE GREAT BEAR BATHOLITH

H HEPBURN METAMORPHIC - PLUTONIC BELT: INCLUDES THE AKAITCHO GROUP AND SOME METAMORPHOSED ROCKS OF THE EPWORTH AND SNARE GROUPS

E EPWORTH GROUP

S SNARE GROUP

the Coppermine region evaluated the copper potential of the Rae Group.

Norman Hennel trenched and sampled REE-bearing volcanics and volcaniclastics of the Port Radium and Echo Bay Formations on the SCANDIUM claim near Surprise Lake (86 K/4) *{3 in Fig. 4}*.

SOUTHEAST MACKENZIE and GREAT SLAVE PLAIN

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B.P. Resources Canada Ltd. did some geochemical sampling of claims near the Horn Plateau (85 K and L) *{1 in Fig. 5}*.

Cominco Ltd. did gravity and airborne magnetic surveys on claim blocks near Racoon Lake (85 K/13,14), Mink Lake (85 F/14) and Chedabucto Lake (85 J/5,6) *{2,3 & 4 in Fig. 5}*.

PNC Exploration (Canada) Ltd. did time-domain EM geophysical surveys and drilled 9 holes totalling 1774 m on the BOOM 1 and 2 claims at Boomerang Lake near the west edge of the Thelon Basin (75 I/10) *{5 in Fig. 5}*.

ARCTIC ISLANDS

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NWT Geology Division, DIAND

The Arctic Island region was one of the few areas in Canada which had a considerable increase in exploration and expenditures in 1991. However, it continues to account for only a small proportion of NWT or Canadian mineral exploration.

Noranda Exploration Ltd., on behalf of joint-venture partners **Highwood Resources Ltd.** and **Aber Resources Ltd.**, did airborne EM and magnetic surveys, ground geophysics, mapping and prospecting of 12 contiguous prospecting permits and claims, and drilled 19 holes (2400 m) in copper-cobalt-silver prospects in Proterozoic sediments near Hadley Bay northeast Victoria Island (77 G/10,11; 86 B/2,7) *{1 in Fig. 6}*.

Cominco Ltd. completed 10 holes (2700 m) and IP surveys on a lead-zinc showing on eastern Truro Island (68 H/7) *{2 in Fig. 6}* near their Polaris mine on Little Cornwallis Island. Cominco also flew airborne VLF-EM surveys of their holdings in the Cornwallis Lead-Zinc District and mapped and surveyed claims on Cornwallis Island (58 G/NW) *{3 in Fig. 6}*.

Nanisivik Mines Ltd. was active on northern Baffin Island. They drilled in the Oceanview area and DEB claims, northeast and southeast of their mine (48 C/1) *{4 in Fig. 6}*. They also gridded, surveyed and drilled Mississippi-Valley-Type Pb-Zn targets in Proterozoic carbonates at Hawker Creek (48 A/13) *{5 in Fig. 6}* and three areas in prospecting permits near Surprise Creek (48 A/13, B/16) *{6 in Fig. 6}*. At Mary River (37 G/5,11) *{7 in Fig. 6}* they drilled 6 holes (500 m) in volcanogenic massive sulphide targets to test for copper, lead, zinc and precious metals. Gridding, geology and geophysics were done on prospecting permits near Eqe Bay and Grant Suttie Bay (37 C/9) *{8 in Fig. 6}*).

Comaplex Resources International Ltd. and **Agnico Eagle Mines Ltd.** did lithogeochemical surveys in areas underlain by sulphidic schists and rusty iron formation of the Archean Piling Group in Central Baffin Island. Work was concentrated in four prospecting permits near Dewar Lakes (27 B/12,13; 37 A/16) *{9 in Fig. 6}* and eight permits near Flint Lake (37 D/2,3,6,7) *{10 in Fig. 6}*.

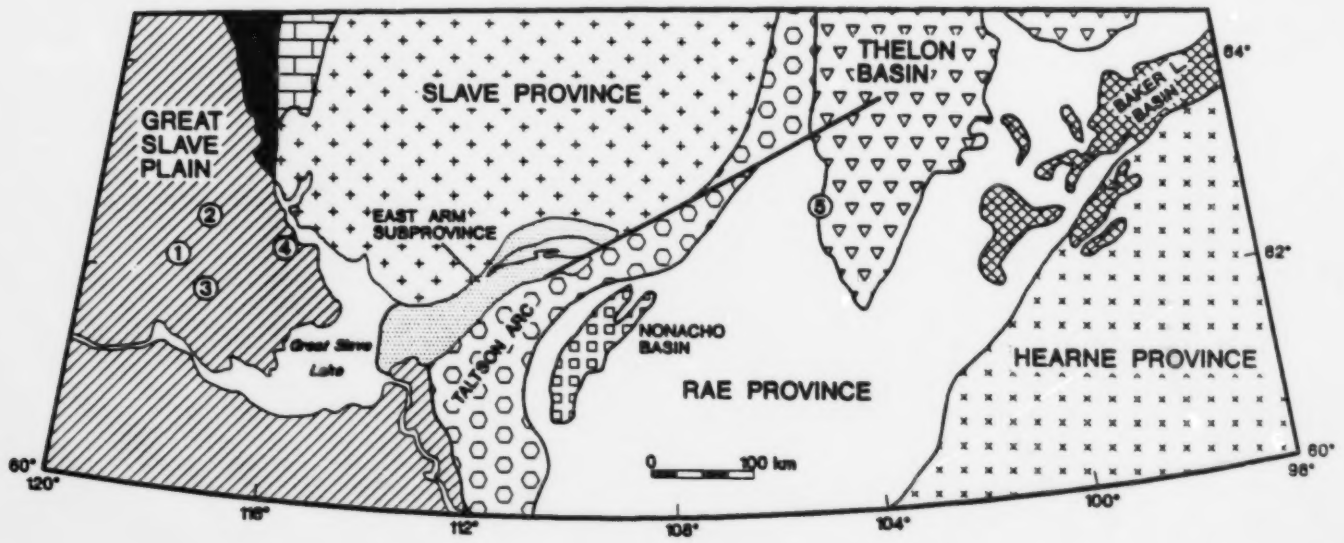

FIGURE 5: Projects in the Southeast Mackenzie and Great Slave Plain.

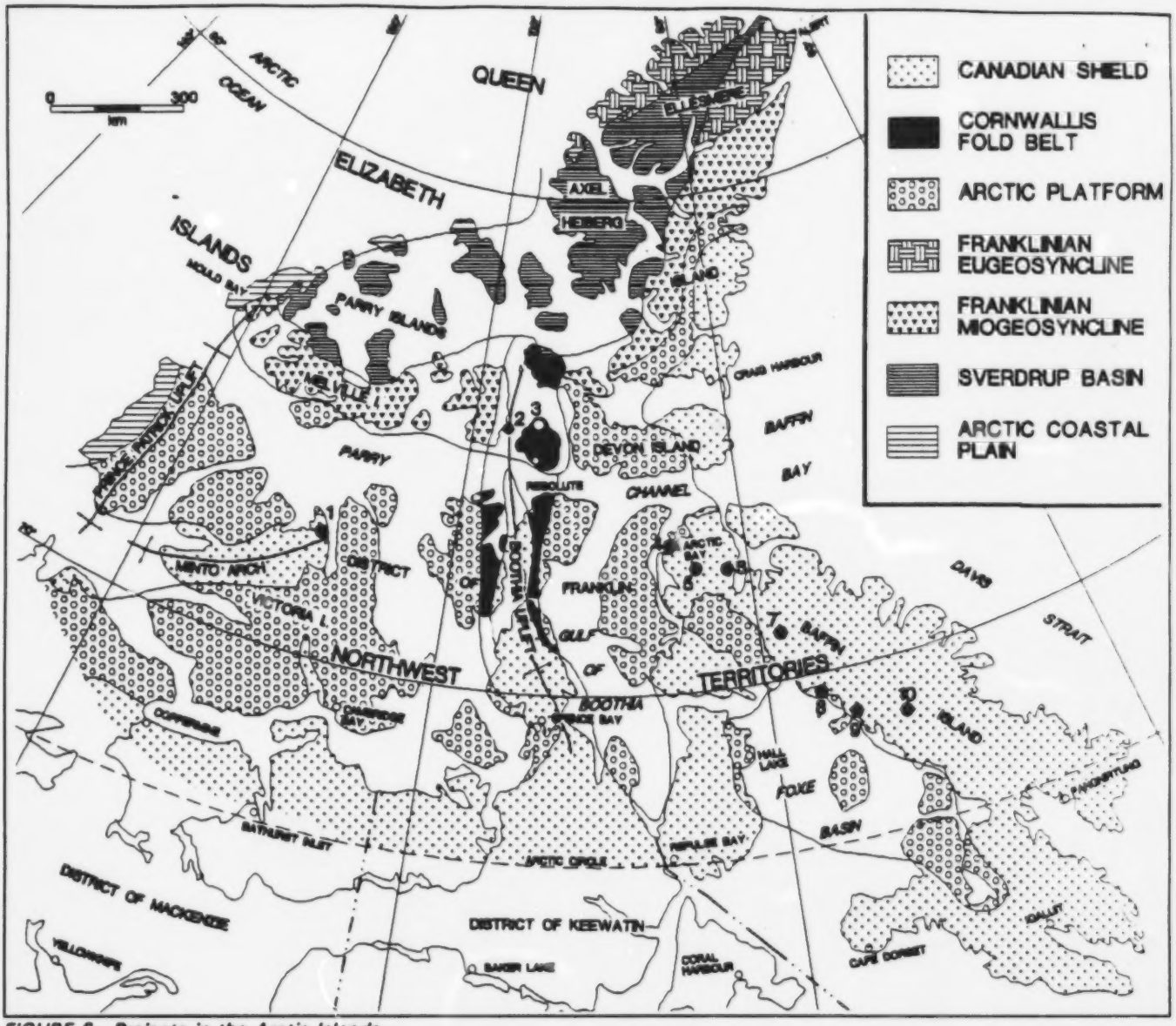

FIGURE 6: Projects in the Arctic Islands.

DISTRICT OF KEEWATIN

S.P. Goff
NWT Geology Division, DIAND

(Exploration is for gold unless otherwise noted.)

Asamera Minerals Inc., in a joint venture with **Comaplex Minerals Corp.** carried out mapping, lithogeochemical sampling, a 4000 line-km airborne magnetic and VLF survey, and a 1000 line-km airborne coaxial EM survey on the NAT claims and adjacent permits in the Meliadine River area (55 J,K,N,O) northeast of Rankin Inlet. In the Discovery Zone area (55 J/13) *{1 in Fig. 7}*, 4540 m of drilling and a ground magnetic and VLF survey was completed. In the Western Lands project area (west of the Discovery Zone), magnetic, VLF and horizontal-loop MAXMIN surveys and 730 m of drilling were completed and new claims were staked (NAT 34-41; 55 N/1,2). New permits east of Peter Lake (PP 1282-1284; 55 N/2) *{2 in Fig. 7}* were explored.

Comaplex Minerals Corp. prospected and mapped the TAV claims in the Copperneedle River area (55 K/4) *{5 in Fig. 7}* and on new permits in the Parker Lake-McQuoid Lake area (PP 1272-1275, 1278, 1279; 55 M/6,7) *{4 in Fig. 7}* as well as in the Poorfish Lake-Windy Lake area (PP 1276, 1277, 1280, 1281; 65 C/8,9) *{15 in Fig. 7}*. Follow-up prospecting took place on permits in the Montgomery Lake-Otter Lake area (PP 1233-1237, 1251; 65 G/1,8, H/4,5) *{12 in Fig. 7}*.

Kaminak Resources Ltd. prospected a new permit at Machurn Lake, northeast of Peter Lake (PP 1265; 55 N/7) and staked two new claims at the southeast end of Gibson Lake (55 N/6,7) *{3 in Fig. 7}*.

On behalf of **Lucky Eagle Mines**, **Agnico Eagle Mines Ltd.** and **Hecla Mining Company of Canada Ltd.**, **W.A. Hubacheck Consultants Ltd.** mapped, performed magnetic and UTEM surveys and drilled 3990 m in the Meadowbank River area (66 H/1) *{18 in Fig. 7}* on claims held by Asamera Minerals

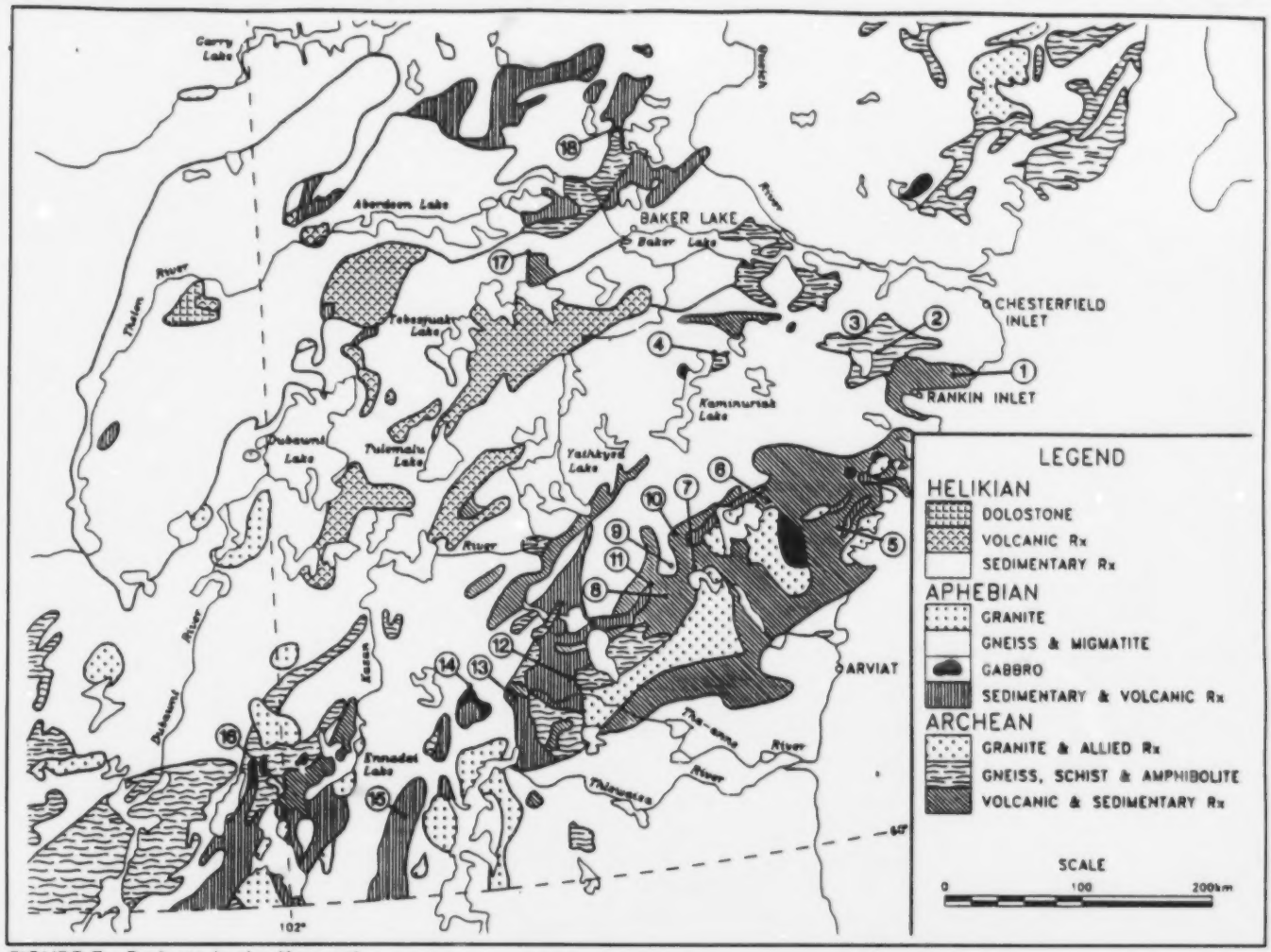

FIGURE 7: Projects in the Keewatin.

Inc. and **Comaplex Minerals Corp.** Also on behalf of Lucky Eagle Mines, W.A. Hubacheck Consultants Ltd. staked eight claims in permit areas 1170 & 1171 (65 C/12, D/9) *{16 in Fig. 7}*, southwest of Ennadai Lake.

Noranda Exploration Co. Ltd. conducted reconnaissance exploration in the Keewatin District and staked two claims north of Watterson Lake (65 G/6) *{14 in Fig. 7}*.

Norstrat Exploration Inc. staked three claims south of Kinga Lake (65 H/15) *{11 in Fig. 7}*.

Placer Dome Inc., as part of an option agreement with **MH Resources Inc.** (a consortium of Dejour Mines Ltd., Noble Peak Resources Ltd. and private investors) mapped, prospected and carried out a reconnaissance evaluation on the TURQ, JOYCE & SPI claims (55 E/13, L/4; 65 H/16, I/1) *{7 in Fig. 7}* at Turquetil Lake and the MAG, PAD & CAR claims (55 L/4,5; 65 H/9,16, I/1,8) *{8,9 & 10 in Fig. 7}* in the Heninga Lake to Car Lake areas.

Placer Dome Inc., as part of an option agreement with **Noble Peak Resources Ltd.**, mapped, prospected and carried out a resource evaluation on the MG and MJ claims (55 L/2,7,8) *{6 in Fig. 7}* of the Southwin Project between Kaminak and Quartzite Lakes.

Suncor Inc. Resources Group and **Comaplex Minerals Corp.** carried out mapping, trenching, lithogeochemistry and VLF and magnetic surveys on permits (PP 1229-1232) and claims in the Hawk Hill Lake-Griffin Lake area (65 G/2,7) *{13 in Fig. 7}*.

Urangesellschaft (Canada) Ltd., in conjunction with **PNC Exploration (Canada) Co. Ltd.** and **Daewoo Corp.**, performed VLF, resistivity and magnetic surveys, and drilled approximately 10900 m on uranium prospects on leases, claims and permits in the Judge Sissons Lake-Schultz Lake South area (66 A/5, B/1,8) *{17 in Fig. 7}*. A new permit to the south (PP 1264; 66 A/4) was prospected, and 23 new claims were staked, mainly in permit areas PP 1161-1163 & 1264 (66 A/4,5).

DERIVATION OF TEMPORAL INFORMATION FROM A GIS: AN EXAMPLE FROM THE NORTHWEST TERRITORIES, CANADA

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Implementation of large-scale Geoscience Spatial Information Systems is the goal of many geological surveys around the world. Geological maps, stored in a seamless map data base, would be the major component of these systems. A fundamental problem, inherent in the creation of these vast digital map data bases, is the loss of temporal information essential to the interpretation of the geological history from the map.

To solve this problem, a system is being developed that will integrate concepts and techniques from the field of expert systems with geographic information systems (GIS) technology. A digital compilation of government survey maps, with a geographic extent of approximately 145 000 square kilometres, is the map data base for development of this system. This area covers the known extent of the Hurwitz Group of sedimentary rocks in the Churchill Province of northern Canada. The knowledge base for the expert system module contains facts about fundamental spatial and temporal field relations as well as rules of stratigraphy and basic map interpretation; enabling the system to establish a relative chronology and derive a map legend for any user-selected area.

The ability to derive temporal information from a map data base will prove essential for user queries of custom map areas and automated production of customized maps. It will also greatly enhance the analytical and modelling capabilities of the spatial information system.

METAMORPHIC AND ALTERATION MINERAL ASSEMBLAGES, CON SHEAR SYSTEM, NERCO CON MINE, YELLOWKNIFE, NWT

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The Con Shear System comprises north-northeast-trending, west-dipping, reverse shears that occur within and at the outer limits of the hornblende amphibolite metamorphic aureole of the Western Plutonic Complex. Hangingwall and footwall volcanic sequences consist of lithologically similar 050°-060° trending, steeply southeast-dipping and southeast-younging pillowed and massive basalts. This sequence is intruded by pre-shear gabbro sills and dykes, granitic plugs, and post-shear diabase dykes.

Hornblendes within hangingwall volcanics are compositionally zoned with low Al cores (1-7 wt% Al_2O_3) and high Al rims (up to 15 wt% Al_2O_3). Approaching the Pud Stock hornblende compositions become more homogenous (12 wt% Al_2O_3). Tremolite-actinolite within immediate footwall volcanics at Rat Lake have bimodal compositions (2 and 6 wt% Al_2O_3) and do not demonstrate recognizable zoning patterns. South toward the Pud Fault, footwall volcanics contain more aluminous hornblendes as the shear system transects the Con Thermal Corridor. Labradorite (An_{50-70}) dominates in hangingwall volcanics with slightly more sodic labradorite within immediate footwall volcanics (An_{49-58}). Relict andesine (An_{30-40}) is preserved as discreet patches within both hangingwall and footwall plagioclase. Barren metamorphic qtz-amph-plag veinlets within hangingwall volcanics contain homogenous high-Al hornblendes (10 wt% Al_2O_3) and bytownite (An_{70-80}).

Four major ore types are found within the Con Shear System:

1) wide (10-15 m) variable grade (6-15 g/t) laminated refractory qtz-ser-aspy schists ± internal qtz veining within thick (20-25 m) shears

2) narrow (1-1.5 m) high grade (>10 g/t) cataclastic-textured blue-grey quartz veins with coarse visible gold, stibnite, sulphosalts, and arsenopyrite ± sericite schist haloes within narrow (3-3.5 m) shears

3) laminated quartz veins (1-2 m wide) with ser-chl-qtz schist selvages within 10-m-wide shears

4) narrow (1-1.5 m), variable to high-grade (>10 g/t) quartz veins (both laminated and cataclastic) bordered by narrow (<0.5 m) chlorite-schist selvages that occur within horses and carry appreciable sphalerite, galena, and scheelite.

Retrogression to a greenschist-stable assemblage (cc-ab-chl ± epid ± leuc ± py) intensifies along 030°/80°E-trending sheeted joint domains within 10-15 m of the shear contact. On the immediate hangingwall, bleached (chl-cc-ab-kspar-qtz) calcite-cemented joint breccia becomes increasingly foliated and ankerite-dolomite altered. Hydrothermal alkali feldspar that once formed selvages to early qtz-tourmaline veins is now preserved as granulated domains and in the groundmass of chl-ser schists that occur peripheral to mineralised qtz-ser-aspy-py schists. With continued deformation, first potassium feldspar then albite become unstable and white mica-qtz-sulph forms the stable mineralogy of the shear.

Retrograde mineral assemblages show variations between different ore types. The dominant chlorite species within retrograde chl schists and ore lenses is ripidolite. Fe/Mg ratios demonstrate no significant variation between foliation-parallel chlorite and wispy chlorite associated with pressure shadows and boudins. Rarely, pycnochlorite (high Mg, 0-25 wt%) occurs within cataclastic blue grey quartz veins within the type 2 ore variety. Significant variation in white-mica mineral chemistry occurs between type 1 and 2 ores zones. Highly refractory laminated type 1 ore zones are dominated by Na-micas (paragonitic-muscovite and paragonite); vein-dominated type 2 ores are dominated by muscovite.

Alkali-feldspar alteration becomes unstable in the presence of

CO_2-rich acidic arsenic-bearing fluids. The breakdown of feldspar liberates both Na and Al to the fluid which are mobilised and subsequentially precipitate Na-micas contemporaneous with sulphide and gold deposition with increasing pH. Veined ore types that lack significant alkali feldspar alteration show no association with paragonitic micas.

STRATIGRAPHY, SEDIMENTOLOGY AND STRUCTURE OF THE HENIK, MONTGOMERY LAKE AND HURWITZ GROUPS IN THE BRAY-MONTGOMERY LAKES AND NORTHEASTERN AMETO LAKE (NOOMUT RIVER) AREAS, SOUTHERN DISTRICT OF KEEWATIN: IMPLICATIONS FOR GOLD EXPLORATION

Lawrence B. Aspler, Terry L. Bursey and A.N. Le Cheminant
(Contribution to the Canada-NWT
Geoscience Initiative 1991-1996)

Three angular unconformity-bounded supracrustal packages are exposed in the Bray-Montgomery and northeastern Ameto Lakes area (65 G,H): the Henik Group (Archean), the Montgomery Lake Group (age uncertain) and the Hurwitz Group (Early Proterozoic).

The Henik Group forms a northeast-dipping homocline (minimum thickness: 11 km) that consists of (in ascending order): 1) unit A1, a mixed sedimentary-felsic volcanic assemblage cut by gabbro sills and dykes (with magnetite iron formation-bearing sandstone to mudstone turbidites, and local quartz-rich sandstones and intraformational conglomerates); 2) unit A2, magnetite-chert banded iron formation (interbedded with felsic tuffs, but uncontaminated by other siliciclastic rocks); 3) unit A3, a mafic volcanic/gabbro sill-dyke complex (with local late feldspar-quartz sills and dykes) and 4) unit A4, a graded sandstone to mudstone turbidite sequence (apparently devoid of volcanic rocks and gabbroic intrusions).

The Montgomery Lake Group is exposed as erosional remnants that mantle a low-relief paleotopography cut into previously tilted Henik Group strata. It represents a westward-draining fluvial plain (planar and cross stratified subarkoses) with basal paleochannel deposits (stratified and channelized polymictic conglomerates), local basal talus deposits (breccias rimming paleohills) and local ponds(lenses of subarkose, siltstone and mudstone). An angular unconformity separates the Montgomery Lake Group from the Hurwitz Group in the Montgomery type area. In the Noomut River area, rocks previously mapped as "Montgomery Lake Group" are considered basal Hurwitz Group (Maguse Member)and are conformable with the remainder of the Hurwitz Group section (see Bursey and Aspler, this volume).

The Hurwitz Group represents sedimentation in an intracratonic basin unrelated to collisional events in Trans-Hudson Orogen. Mechanisms for basin subsidence and intrabasin arching are uncertain, but may reflect intraplate stress arising from eastward subduction beneath the northwestern Rae Province during convergence of the Chinchaga and Buffalo Head terranes, or from extensional processes related to the opening of the Manikewan Ocean. The lower part of the section records a terrestrial to marine transition. Lenses of Padlei Formation represent local paleovalley mass flow, fluvial and lacustrine deposits (glacial or periglacial) filling depressions cut into Archean basement (massive polymictic paraconglomerate with mixtite matrix; stratified polymictic orthoconglomerate with arkose matrix; stratified arkose; pelitic rhythmites).Maguse Member (Kinga Formation) fluvial (+/- lacustrine and eolian) deposits conformably onlap the Padlei Formation but unconformably overlie Montgomery Lake and Henik Groups (basal polymictic pebbly arkoses, quartz-jasper pebble conglomerate grading upward to subarkose-quartz arenite; local subarkose-quartz arenite mudstone lenses; local large-scale high-angle cross-stratified quartz arenite). Whiterock Member (Kinga Formation) wave-dominated shallow marine (locally emergent) supermature quartz arenite shelf deposits conformably onlap the Maguse Member and Padlei Formation and reflect basin subsidence that extended beyond the limits of underlying units (basin widening concurrent with sea-level rise; transgressive reworking of underlying units). Hawk Hill Member cherts represent sporadically developed,topographically elevated sinter terraces formed on a substrate of shallow water to emergent Whiterock Member quartz sands (see Aspler, this volume). The end of sinter deposition, the preservation of the sinter piles and the abrupt appearance of immature siliciclastic debris are attributed to sudden drowning of the Kinga shelf concurrent with uplift along a northeast-trending arch between Bates and Griffin Lakes. The basin narrowed and deepened in an offlap sequence prograding away from the arch with: a distal ramp, below wave base pelite facies (Ameto Formation, pinching out to the northwest); an inner ramp carbonate facies (Watterson Formation, with basement and Whiterock Member clasts in basal units on the northwest); a locally-developed siliciclastic (+/- carbonate) lagoonal facies (Ducker Formation lenses at Watterson Formation-Tavani Formation transition); a fringing coastal immature siliciclastic (+/- carbonate) sand facies (Tavani Formation; conformable on Ducker Formation or Watterson Formation on the east; unconformable on basement arch to the northwest).

The principal Proterozoic structural elements are: 1) a NE and E-trending, north-vergent imbricated thrust (north of Montgomery Lake) that juxtaposes Henik Group and lower Hurwitz Group above upper Hurwitz Group; 2) a gently SW-plunging synclinorium (hanging wall of thrust) with minor folds and oblique-slip faults distributed in a box-like array (topographically expressed as the Grey Hills); 3) a gently SW-plunging anticlinorium (footwall of thrust) with minor folds and a south-vergent back thrust; and 4) two NW-trending oblique-slip faults that bound a block of upper-level Hurwitz Group strata west of Bray Lake in which early east-trending folds are refolded by north and NE-trending folds producing a Type II interference pattern.

Cleavage trends, although variable from heterogeneous strain, are predominantly northeast. Early folds in the down-dropped block west of Bray Lake lack an associated cleavage. In the Montgomery Lake Group, a variably penetrative, northeast-trending cleavage (with associated open folds) is concordant with cleavage in the Hurwitz Group. Yet local northwest-trending folds (lacking a related cleavage but transected by the northeast-trending one) are concordant with bedding trends in subjacent Henik Group. It is not clear to what extent the latter are Proterozoic versus Archean structures.Archean rocks in the hanging wall of the east-trending Proterozoic thrust define a moderately to steeply NE-dipping homocline. Northwest-trending folds and cleavage are rare; cleavage trends predominantly to the northeast and appears to intensify toward the Proterozoic thrust. The homocline appears to follow the outline of the Grey Hills synclinorium south of the

map area. In the footwall of the thrust, Archean rocks are folded about northeast-trending axial surfaces and are steeply (50-90°) plunging.

The principal structure in the Noomut River area is a NE-trending, NW-vergent imbricated thrust. In the footwall, the Hurwitz Group and basement are folded about steeply dipping, NW-trending axial surfaces (lacking an associated cleavage) and steeply dipping, NE-trending axial surfaces in a Type I interference relationship. In the hanging wall, the Hurwitz Group and the basement-cover contact are folded in a NW-plunging syncline (with space accommodating, NW-trending cross faults). Yet cleavage trends are predominantly northeast. Archean rocks in the footwall are folded about a NE-trending cleavage; the folds are steeply plunging (>70°; commonly downward-facing). Although Archean rocks are deformed together with the Hurwitz Group, an earlier strain history is indicated by this structural discordance, by the presence of foliated Archean clasts in basal Hurwitz Group units and by the contrast in apparent strain at the Henik Group-Hurwitz Group unconformity.

Gossans mapped and sampled are currently being analyzed; all units are potential gold targets. Principal sites in the Henik Group (with analyses available to date) include: 1) chalcopyrite-pyrite-bearing quartz veins cutting rhyolite agglomerates northwest of Noomut River (1600 ppb Au); 2) pyrite-bearing quartz veins cutting unit A2 banded iron formation west of Montgomery Lake (310 ppb Au; 170 ppb Au; 31 ppb Au); 3) sulphide disseminations along pillow selvages and inter-pillow zones in unit A3, (34 ppb Au; 28 ppb Au); and 4) pyrite-bearing quartz veins at unit A3 pillow volcanic-gabbro contacts (80 ppb Au; 11 ppb Au). Disseminated pyrite gossans are ubiquitous in the Montgomery Group; east of Bray Lake, basal Montgomery conglomerates contain pebble to cobble-sized clasts of pyrite-quartz (to 100% pyrite). Three samples yielded 1600, 480 and 120 ppb Au. Source rocks have not been mapped in basement. We regard pyrite-bearing quartz pebble conglomerates in the Noomut River area (the target of intensive gold-uranium exploration in the early 1960's) as a basal facies of the Hurwitz Group (Maguse Member) and not part of the Montgomery Group (see Bursey and Aspler, this volume). Background gold in the Hurwitz Group is typically below 1 ppb. Above-background gold was recorded from the Padlei Formation west of Bray Lake (190 ppb Au); from the Whiterock Member west of Bray Lake (18 ppb Au) and from a Hurwitz gabbro sill near the upper contact of the Ameto Formation close to the intersection of a Mackenzie diabase dyke (11 ppb Au).

ECONOMIC SIGNIFICANCE OF HOT SPRING CHERTS, THE HAWK HILL MEMBER (EARLY PROTEROZOIC HURWITZ GROUP) DISTRICT OF KEEWATIN: AN UPDATE

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Contrary to previous interpretations, bedded white chert, iron oxide-rich maroon chert, and chert breccias that lie conformably between Whiterock Member quartz arenites and Ameto Formation mudrocks are not siliceous paleosols (silcretes) but sinter deposits formed by surface discharging of silica-enriched hot springs, a lithofacies with few well-documented ancient examples. Amorphous silica (neomorphosed to microquartz) accumulated on sporadically distributed, topographically elevated sinter fans of limited extent, reaching thicknesses of up to 23 m. Asymmetric iron-rich to silica-rich microbands represent the sequence of precipitation from discrete iron- and silica-laden hydrothermal pulses. Breccias were formed by dehydration-induced soft-sediment deformation, surface reworking, and possibly by local hydrothermal eruption. Ascending fluidized waters reworked partially cemented Whiterock Member quartz sands to deposit single grains within chert, and cleared bottlenecks in the underlying plumbing system created by subsurface veining to yield local megaquartz-adularia clasts within breccias. Convective circulation and heating of waters that ascended to form the sinters may be genetically linked to Hurwitz mafic volcanism (Happotiyik Member).

During the 1991 field season, new exposures of the Hawk Hill Member were found southeast of Bray Lake (65 G/8, five sites scattered along a strike length of 20 km), northwest of Montgomery Lake (65 H/5), and northeast of Ameto Lake (65 H/11). Southeast of Bray Lake, steeply dipping cm- to m-scale breccia zones cut gently dipping uppermost Whiterock Member quartz arenites. The breccias consist of Whiterock Member clasts and rare concentrically coated chert clasts (geyserites?) in an iron-oxide-rich maroon chert matrix identical to the conformably layered chert. Wall rock to breccia zone transitions include: 1) *in situ* wall rock (± maroon chert-filled hairline fractures); 2) breccia with jig-saw fit to host rock; 3) imbricated tabular slabs of wall rock in maroon chert; and 4) subrounded to rounded wall rock floating in maroon chert. The discordant breccias are interpreted to mark the position of feeder pipes that channeled waters to the surface. They likely formed through a process of repeated hydraulic fracturing, with fluidized ascending waters resulting in clast-clast attrition and rounding (pseudoconglomerates).

Recognition of the Hawk Hill Member as a sinter deposit opens a new exploration target, in both basement and Proterozoic rocks, that may be added to previously defined structure-controlled models: hot spring gold. Major-element compositions of the Member are comparable to other sinters; trace elements differ, lacking enrichment in Au, Ag, As, Sb, and Ba. Barren sinter caps above hot-spring ore bodies are not unusual: although apparently barren of precious metals, the unit marks sites of hydrothermal processes that may have concentrated precious metals in subjacent units. Although the discordant hematitic breccias (feeder pipes) are not anomalous in gold (maximum 6 ppb), silver (all <0.5 ppm) or arsenic (maximum 11 ppm), they are elevated in other members of the epithermal pathfinder suite (to 77 ppm W; to 44 ppm Sb; to 15 ppm Mo).

* work funded by DIAND, NWT.

NORTHWEST TERRITORIES COMPUTERISED MINERAL SHOWINGS DATABASE (CMSD) AND MINERAL RESOURCES MAP (MRM) PROJECTS

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4 Allegra Management Company, 34 Woodmount Cres., Nepean, Ontario, K2E 5R1
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The Computerised Mineral Showings Database (CMSD) and the Mineral Resources Map (MRM) are collaborative projects between Canada-NWT Mineral Initiatives, Mineral Resources Division of GSC and NWT Geology Division, NAP, DIAND. The projects, which began in August 1991, started by: 1) reviewing available NWT data sources in both digital and paper formats; 2) investigating database management systems and display methods in use or in development by various government departments, academia and industry; and 3) polling and interviewing a variety of potential users to gain an understanding of their data requirements, preferred formats and level of computer expertise.

Our goal is to implement a CMSD which will produce a variety of outputs in useful formats including formats which can be distributed to other personal computers. The geo-referenced CMSD will have a user-friendly interface so that it can be easily used for retrieval, input and updating by government and the public. Data will be entered to the CMSD during the Mineral Initiatives program 1992 - 1996 and subsequently updated by government geologists in Yellowknife. CMSD will be an effective tool to help distribute information and therefore aid exploration and research.

Maps from CMSD at anticipated scales of 1:250 000 and 1:50 000 will be produced in Yellowknife and Ottawa using plotting capabilities in CAD, mapping programs or geographic information systems (GIS). Possible layers for these maps include topography, geology, showings, geophysics, geochemistry and various indices to assessment reports, air photos, GSC maps and reports, DIAND maps and reports, journal articles and theses. It is our hope that CMSD will be directly linked to on-screen graphical presentations that include these layers of information. We will establish suitable networking and other communication capabilities in Ottawa and Yellowknife such that data and equipment can be accessed and shared in both locations.

New Mineral Resources Maps (MRM) of the entire NWT and more specific areas will be developed in Ottawa and Yellowknife from CMSD using a GIS which will be selected from recommendations by consultants A.J. Robinson and Associates Inc. MRM will be used for policy and regional planning and will be made available to the public. Prototype MRM examples for the central Slave Structural Province and south Nahanni River area are planned to be produced before March 31, 1992 as part of a contract with A.J. Robinson and Associates Inc.

A METAMORPHIC-HYDROTHERMAL-DEFORMATIONAL MODEL FOR AMPHIBOLITE FACIES GOLD-BEARING IRON FORMATIONS, RUSSELL LAKE, NORTHWEST TERRITORIES, CANADA

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A tectonically controlled metamorphic-hydrothermal origin is proposed for three iron-formation-hosted gold prospects 120 km northwest of Yellowknife, Northwest Territories. Stratigraphic and structural studies of the mineralized northern part of the Russell Lake area reveal a deformational history similar to other parts of the Slave Structural Province, including batholith emplacement controlled by basement faulting. Late kinematic mineralization is indicated by the structural setting of gold in association with cross-folds that developed during metamorphic cooling and decreasing lithostatic pressure. Pore-fluid circulation was influenced by iron formations functioning as metamorphic aquifers, absorbing large volumes of fluid from structurally weaker source-beds during folding and cooling. A supracrustal source is preferred for the gold, which was mobilized and transported by metamorphic pore-fluids driven by plutonic heat, and deposited in iron formations by sulphidation. The model applies to Precambrian metasedimentary and metavolcanic sequences that have been subjected to amphibolite grade regional metamorphism.

THE USAGE OF FIELDLOG IN GEOLOGICAL FIELD MAPPING

Boyan Brodaric
Geological Survey of Canada, Ottawa

Transforming geological maps and field observations into digital products is a laborious and time consuming exercise, which realizes no benefits until the lengthy process is complete. Traditional non-digital methods are even less attractive, often incurring much duplication of effort in the scaling and editing of maps and the frequent conversion of field notes into various formats suitable for analysis and reports, usually involving some computer software in the end. The aim of Fieldlog is to eliminate such wastage and redundancy by providing a means of generating a comprehensive digital database and electronic map for the project at its source, in the field, where the system becomes integral to the daily routine. It replaces manual drafting with digital data entry and computerized cartography, and provides geologists with the benefits of computer technology during the active portion of the project, where it aids interpretation and map construction.

Fieldlog accomplishes this by allowing the geologist to tailor a database to the needs of the project and according to his or her specific expertise. It can operate on the smallest PC laptop in the field, or any desktop PC in the office. Fieldlog provides tools to ease data entry, either into a database or directly onto a digital map, and also mechanisms which allow any portion of the map or database to be revised. Likewise, any subset of the database may be exported to a text file for reports, or to a graphic DXF format from which it can be viewed, changed, rescaled, integrated with digital topographic maps and plotted on small printers or plotters using a CAD program. Data entered directly onto a digital map via the AutoCAD system will also be seamlessly transferred to the database, permitting

geologists the option of entering data either into the database or graphically onto the map, as personal preference, but also costs, dictate. Fieldlog creates and maintains dBase compatible databases, and will import columnar text data; it also allows Easting, Northing or Lat, Long coordinates to be rapidly and accurately digitized with a tablet from an air photo or map, directly into the database. Data collected and stored in this manner is easily accessible and thus easily integrated into digital reports and publications, as well as into custom analytical software and GIS.

STRUCTURAL AND SEDIMENTARY ENVIRONMENT OF GOLD-BEARING BANDED IRON FORMATION (BIF) IN THE WHEELER LAKE DOMAIN, AND CONTRASTS WITH THE BIF-BARREN YELLOWKNIFE SEDIMENTARY DOMAIN.

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The Wheeler Lake Domain is a 70-square-km area of supracrustals centred 100 km north-northwest of Yellowknife in NTS 85 O/7. It is underlain predominantly by amphibolite-grade sediments of the Yellowknife Supergroup, and is surrounded by granite and migmatite. The sediments are intercalated with silicate-rich banded iron formation (BIF) up to several tens of metres thick, and these occasionally grade into sulphide-rich BIF containing pyrrhotite (± pyrite, arsenopyrite, gold). The thickest BIF unit(s) are exposed at or near the axial trace of a major, east-trending syncline that bisects at least the west half of the Wheeler Lake Domain. To the north of the main BIF unit(s), beds face predominantly southwards and cleavage-bedding relationships are predominantly clockwise. To the south of the main BIF unit(s), beds face towards the north, although cleavage-bedding relationships are still mainly clockwise. Cleavage, therefore, is younger than the major syncline and younger than the parasitic (or possibly earlier) folds established on the flanks of that structure. A locally developed crenulation cleavage, usually at a high angle to bedding and the main foliation, is the youngest of the three or four generations of structures that have been documented in the Wheeler Lake Domain.

The best gold showings are equally divided between structurally complicated areas where BIF is refolded, and straight limbs where there is no evidence of structural complexity. BIF, in turn, is spatially associated with the finest-grained and thinnest-bedded sediments of the domain; typically knotted cordierite–andalusite schists disposed in beds less than 4 cm thick.

Mesoscopic observations in the Wheeler Lake Domain strongly suggest that gold mineralization predates peak metamorphism. The most compelling evidence for this comes from a sample of auriferous (>30 ppm gold) garnet-porphyritic sulphide-rich iron formation carrying 5% to 10% very fine-grained pyrrhotite evenly disseminated within both the matrix and the porphyroblasts. Since ore-tenor gold grades are always associated with sulphidic iron formation, it is reasonable to conclude that the gold, as well as the sulphides, were present in the rock prior to the development of garnet porphyroblasts. This is in contradistinction to interpretations of the timing of a similar type of mineralization at Lupin Mine, where Bullis *et al.* (in this Overview) report that gold introduction postdated peak metamorphism.

Investigations at Wheeler Lake have not established whether gold mineralization is syngenetic or epigenetic; but the elevated gold clarke of non-sulphidic, silicate iron formation (avg. 27 ppb), the lack of systematic spatial relationships of gold mineralization to quartz veins, and the mineral textures described above all support the possibility that the gold might be syngenetic.

Compared to the Yellowknife Sedimentary Domain, which is devoid of silicate BIF, the sediments of the Wheeler Lake Domain are distinctly finer grained, thinner bedded, and associated with a much higher proportion of interbedded felsic to intermediate volcanic rocks.

CONTROLS OF GOLD AND SULPHIDE DISTRIBUTION AT LUPIN, N.W.T.

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Lupin is located on the shores of Contwoyto Lake at lat. 65°48'N, long. 111°15'W (76 E/10) and lies about 80 kilometres south of the Arctic Circle. Since start up in 1982 the mine has produced over 1.67 million ounces (52 000 kg) of gold from 5.56 million tons (5.04 million tonnes) of ore grading 0.316 oz/ton (10.84 g/t). 1990 year-end reserves totalled 4.45 million tons (4.04 million tonnes) grading 0.310 oz/ton (10.63 gm/tonne) in the proven and probable categories with an additional 1.85 million tons (1.67 million tonnes) of possible reserves grading 0.259 oz/ton (8.88 gm/tonne). Annual gold production is about 200 000 ounces (6200 kg). The main ore zones of the deposit are open to depth.

The deposit is in an Archean metaturbidite sequence of the Contwoyto Formation, which has been mapped as part of the Yellowknife Supergroup of supracrustal metasedimentary and metavolcanic rocks making up part of the Slave Structural Province. These rocks have been subjected to regional and contact metamorphism and to several phases of deformation. Six stages of Archean plutonism have been identified and all Archean rocks have been cut by Proterozoic diabase dyke swarms.

Gold mineralization in the Lupin deposit is commonly fine grained and associated with the sulphides pyrrhotite and arsenopyrite. The gold-bearing portions of the iron formations are characterized by the presence of multiple quartz veins and the pervasive replacement of grunerite by hornblende. In the more poorly mineralized portions of the iron formation horizons, sulphides are clearly zoned about quartz veins with the arsenopyrite halo being more restricted than the pyrrhotite halo. In the well-mineralized portions of the deposit, quartz-vein densities approach one vein per metre. In these areas pyrrhotite distribution in the iron formation is more pervasive and the rock takes on the appearance of a banded sulphide.

D1 and D2 deformational events have resulted in steeply dipping fold limbs and steeply plunging fold noses at Lupin. The interaction of these two early events have formed the modified domal structure which characterizes the Lupin deposit. A post-D2 event (DNE-DNW) resulted in folding about axes trending both NE and NW in the Lupin region. This event postdates peak regional metamorphism and is related to the relatively undeformed quartz veins which are in turn related to sulphides and gold mineralization in the iron formation horizons.

Geological mapping and detailed sampling studies have clearly shown that both gold assays and sulphide concentrations are highest within one metre of quartz vein/iron formation contacts and decrease rapidly away from vein margins. In the more poorly mineralized portions of the deposit it is not uncommon to observe a transition from sulphide-rich iron formation to sulphide-free iron formation as distances from quartz vein/iron formation contacts increase. Quartz veins bearing elevated gold up to several ounces per ton have been identified in detailed sampling studies.

The Lupin gold deposit was formed subsequent to peak regional metamorphism probably by gold-bearing metasomatic fluids circulating in the cooling sedimentary pile and channelled along structures resulting from DNW-DNE deformation. The iron formation horizons are host to sulphide and gold mineralization possibly due to their iron-rich chemistry. An alteration of the iron from predominantly grunerite rich to predominantly hornblende rich is part of the mineralizing event.

THE MONTGOMERY LAKE GROUP, SOUTHERN DISTRICT OF KEEWATIN: CONTACT RELATIONSHIPS, INTERNAL STRATIGRAPHY, STRUCTURE AND ECONOMIC GEOLOGY

Terry L. Bursey and Lawrence B. Aspler
(Contribution to the Canada-NWT
Geoscience Initiative 1991-1996)

The Montgomery Lake Group is preserved as erosional outliers that truncate Archean Henik Group stratigraphy at an angular unconformity. The unit consists of four facies. Basal polymictic conglomerates, of limited extent and thickness, have clast compositions that reflect adjacent basement rock types. The conglomerates are framework intact, have a coarse arkose matrix, and have local arkose interbeds. Local broad channels indicate westward paleoflow. Basal framework-intact breccias consist of Archean BIF fragments in a pebbly sandstone matrix (adjacent to *in situ* BIF). The principal facies is medium to coarse-grained, commonly cross-bedded subarkose. Cross beds from the subarkose facies display a paleoflow pattern that is complex in detail; data grouped from the entire unit indicate primarily west, southwest and northwest paleoflow. Lenses of interbedded subarkose, siltstone and mudstone (with local ripple marks, mudcurls, mudchip breccia) are within the subarkose facies.

We envision that a low-relief sub-Montgomery paleotopography (with local paleohills mantled by talus slopes) was buried by a westward-draining, low-gradient fluvial system with local ponds filling depressions within the fluvial plain.

Contact relationships between the Montgomery Lake and Hurwitz Groups have been controversial. In its type area, an angular unconformity separating the two units is indicated by a rare exposure in which breccia at the base of the Hurwitz Group (containing clasts of subjacent Montgomery Group) truncates previously tilted Montgomery Group strata, and by map patterns in which Montgomery Group outliers are oblique to, and are apparently truncated by, the Hurwitz Group. In the Noomut River area we suggest that there is no fundamental difference between rocks historically mapped as Montgomery Lake Group (and which were the target of intensive gold-uranium exploration in the early 1960's) and the Maguse Member of the Hurwitz Group; that the difference between these rocks and type-area Montgomery Group is marked; and that the rocks previously mapped as Montgomery Group in this area constitute the lower part of a conformable Hurwitz Group section.

At Montgomery Lake, early folds lack an associated cleavage and are NW-trending, concordant with bedding trends in the subjacent Henik Group. These folds are transected by a variably penetrative pressure-solution cleavage which is axial planar to local folds that are NE-trending, coincident with cleavage in the Hurwitz Group. The age of the Montgomery Lake Group is uncertain. It may be Archean and represent a molassoid sequence developed late in the history of the Ennadai-Rankin greenstone belt; alternatively it may be Aphebian and represent a precursor to Hurwitz Group sedimentation. Also unknown is the original extent and nature of the Montgomery Lake Group. Examination of clast compositions in lower Hurwitz Group units and detrital zircon geochronology may help to resolve these problems.

Gossans from disseminated pyrite are ubiquitous in the Montgomery Lake Group. East of Bray Lake, basal polymictic conglomerates contain pebble to cobble-sized clasts of pyrite-quartz. Three analyzed samples contained 1600, 480 and 120 ppb Au. Basement rocks that could have been the source of the clasts have not yet been mapped east of the gossan.

THE EVOLUTION OF AURIFEROUS METAMORPHIC FLUID: YELLOWKNIFE GREENSTONE BELT, NWT

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Pervasive spilitization of mafic pillow lavas and amphibolitization of gabbroic sills of the Yellowknife Greenstone Belt stem from geothermal activity accompanying Kam Group submarine volcanism. Due to this early seafloor metasomatism, voluminous mixed CO_2-H_2O fluids were released by decarbonation/dehydration reactions occurring within the prograde metamorphic aureole to the Western Granodiorite. Retrogressive fluid/rock reactivity caused widespread high-temperature calcsilicate replacement and more focused carbonation and hydration of fluid conduits as temperatures waned. Calcsilicate replacement of amphibolite generated a reduced CO_2-H_2O-rich fluid, while subsequent hydrothermal alteration led to a strongly acidified gaseous fluid rich in dissolved silica and sulphur species. This evolved fluid phase effectively stripped metals from conduit walls. Gold precipitated within ankerite-sericite-pyrite alteration zones with destabilization of thio complexes through sulphidization. The silica released by wholesale wallrock carbonation and sulphidization silicified ductile shear bands and ponded to form quartz veins in dilational structures.

The time involved from initial prograde metamorphic fluid production to final retrogressive metasomatic fluid consumption broadly coincided with the emplacement and exposure of the Western Plutonic Complex. Metamorphic devolatilization of the thermal aureole to this batholith occurred as long-lived reverse shears accommodated isostatic adjustments following emplacement. Gold was concentrated in specialized fluids as a result of stepped fluid-rock reactions taking place during cooling over a considerable (50 m.y.) time

span. With important implications for exploration, this metamorphic model predicts that gold lodes essentially form *in situ*, and have no direct link to igneous activity at depth.

METALLOGENY OF THE SLEEPY DRAGON COMPLEX, SOUTH-CENTRAL SLAVE PROVINCE, NWT

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The Sleepy Dragon Complex (SDC) 100 km east of Yellowknife is a late Archean gneiss dome. Apophyses of infrastructural peraluminous to alkaline granites coring the dome infiltrate high-grade gneisses juxtaposed against supracrustal greenstones and sediments. From north to south along the western side of the complex a mylonitic carapace to the internal lit-par-lit gneisses transects basement quartzite and iron formation, attenuating the overlying Cameron River Greenstone Belt. South of the pinchout of the Cameron River volcanics, amphibolitic greenstone and mylonitic granite clasts make up the onstrike "conglomerates" of the Raquette Formation. These moderately flattened to strongly lineated clasts are typically free-floating in a gossanous calcsilicate matrix which is mineralogically identical to calcsilicate veins and breccias ramifying through adjacent mylonitic gneiss. Carbonate occurs locally as veins transecting the mylonitic fabric and as lenses within the calcsilicate conglomerate. South of the Raquette Formation, mylonitic gneiss borders on cordierite-facies metaturbidites of the Burwash Formation. Argillaceous units proximal to the mylonitic front are strongly sulphidic, while more distal felsic members locally host disseminated arsenopyrite.

The SDC has an unusually varied metallogenic association due to juxtaposition of differing crustal levels. The rare-metal-bearing pegmatites of the Ross Lake Field are zoned toward the fertile Redout Lake Granite. Extensive pyrrhotite-bearing skarn with local magnetite, chalcopyrite, and molybdenite concentrations occurs along the calcsilicate-altered mylonitic front, accounting for the prominent gossanous topographic ridge which rims the complex. The strong CO_2 fluidization of the mylonitic front postdated peak metamorphic conditions and possibly coincided with the emplacement of the Redout Lake alkaline granite. Metamorphic lode gold, volcanogenic polymetallic massive sulphide, and chert-magnetite iron formation deposits are hosted in the peripheral volcanics and sediments.

HISTORY OF MINING IN THE NORTHWEST TERRITORIES

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Long before Europeans began to explore what is now northern Canada, Inuit quarried metal and rock for tools. Native copper and iron from meteorites were traded across the north for use in tools such as fish hooks and ulus. Martin Frobisher, the first European explorer to attempt mining, mined "gold ore" from Kodlunarn Island near Baffin Island. Prior to 1930 there had been a few attempts at small-scale mining in the Arctic Islands and in the eastern Arctic: mica was mined near Niante Harbour in 1874; both mica and graphite were mined discontinuously near Lake Harbour between 1909 and 1918; and gold was mined at Term Point on Hudson Bay in 1928.

There had been some exploration for base metals and precious metals in the early part of the century, but it was not until Gilbert Labine discovered silver and pitchblende at Great Bear Lake in 1930 that exploration and mining began in earnest in the NWT. The "dirty thirties" brought men who had few business prospects in southern Canada north to seek their fortunes. In 1932 there were between 200 to 300 men, mainly prospectors, working in the area east of Great Bear Lake. In 1933 the modern mining era began in the NWT with the opening of the Eldorado Mine on the shores of Great Bear Lake. The discovery of gold in 1934 on the east side of Yellowknife Bay, the RICH claims, shifted the focus of exploration to gold in the area north of Great Slave Lake. The following summer a GSC officer discovered gold on the west side of Yellowknife Bay. The CON claims were staked in 1935; in September 1938, Con Mine poured the first gold brick in the Northwest Territories. The discovery of visible gold in the Indin Lake area in 1938 resulted in a staking rush during 1938 and 1939. The shear system hosting the Giant deposit was discovered in 1944 and Giant Yellowknife Gold Mines poured its first gold brick in June 1948.

Since 1930 more than 25 gold mines have produced approximately 450 000 kg (14.4 million oz.) of gold. Over 95% of the gold has come four mines: Giant Mine (44%), Con Mine (32.8%), Lupin Mine (11.8%) and Discovery Mine (7%). Three lead-zinc mines, Pine Point, Nanisivik and Polaris, have produced 4 200 000 t of zinc and 1 190 000 t of lead; Pine Point Mines contributed roughly half of the zinc and lead produced to date. Other commodities extracted from 11 mines include 1920 t of silver, 42 000 t of WO_3, 6110 t of U_3O_8, 10 150 t of copper and 9700 t of nickel.

REGIONAL DISTRIBUTION OF GOLD AND OTHER ELEMENTS IN THE YELLOWKNIFE MINING DISTRICT, NWT (NTS 85 J/7,8,9&16)

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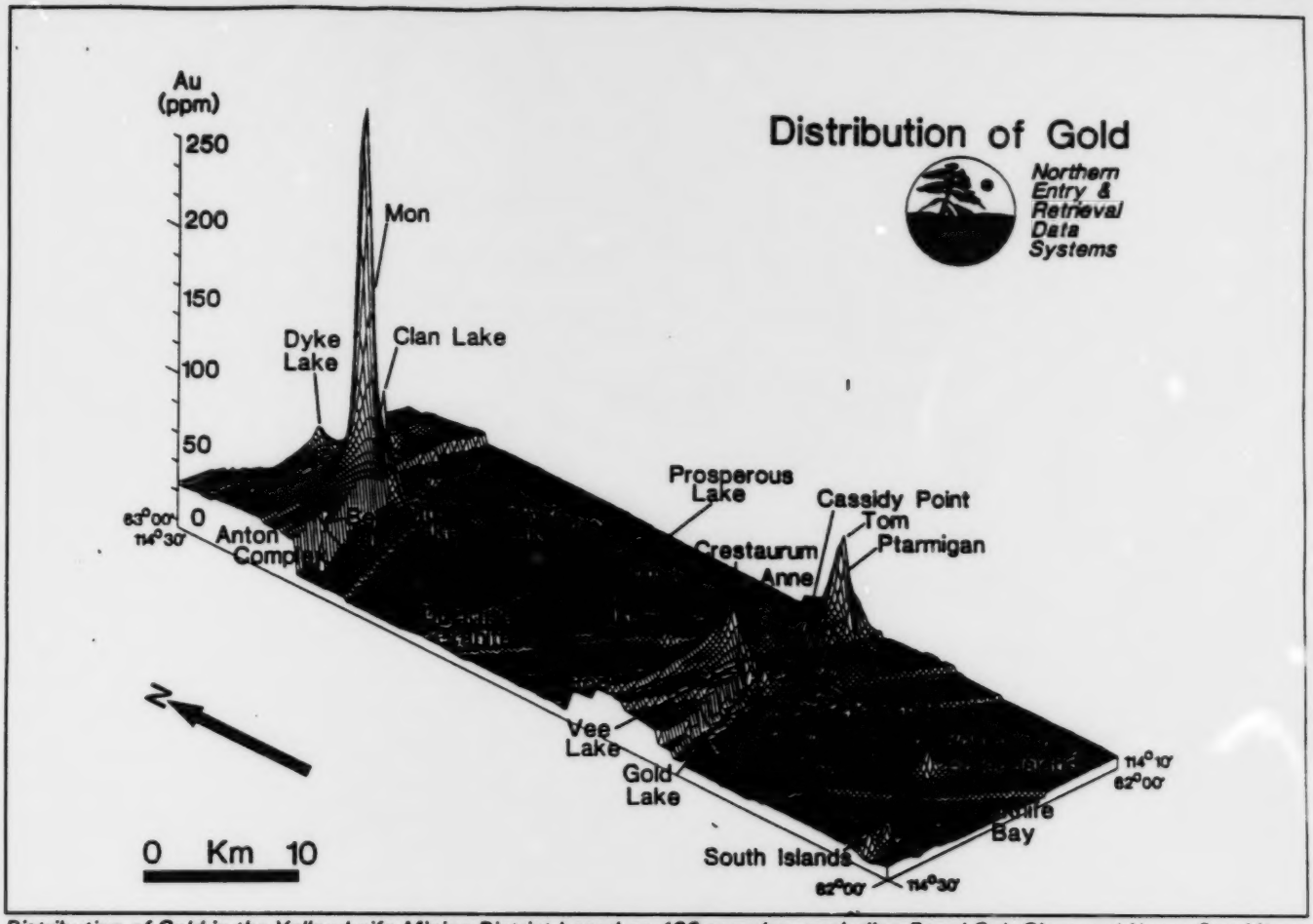
The wealth of gold resources in the Yellowknife Mining District is readily apparent. The Yellowknife area has the highest density of mines and gold showings in the Northwest Territories, in part due to six decades of intensive exploration. Many models have been proposed to account for gold enrichment and to suggest potential gold sources. However, the vast majority of these proposals were based on single showings, where not all mineralization, deformation or metamorphic events are represented, or on large-complex deposits, where early events are commonly overprinted and obscured.

In order to develop a regional picture, a suite of 400 samples from 220 showings, mainly gold showings, was collected and analyzed. Using this data set and commercial computer programs, it was possible to construct three-dimensional frequency distribution plots of different elements (e.g. Figure). Geographic coordinates were plotted on the X and Y axes and element concentrations on the Z axis. A spatial frequency distribution technique known as kriging was used to calculate a three-dimensional surface. Several factors, including irregular distribution of sample sites (known showings), select grab



Distribution of Gold in the Yellowknife Mining District based on 400 samples, excluding Royal Oak-Giant and Nerco-Con Mines.

sampling and boundary conditions, can induce artificial shapes. Consequently, statistical extrapolations cannot be used to predict actual concentrations on the ground. However, the approach simplifies examination of the spatial distribution of large data volumes. Single-element plots emphasise the spatial distribution of samples with high element concentrations. Consequently, single samples from a thin vein with abundant gold (e.g. Mon Property) plot as very prominent peaks, whereas samples of large volumes of ore-grade rock may not be very pronounced above background (e.g. C16 and C20 shears).

With consideration of these caveats, single-element distribution plots display a number of readily apparent features. Arsenic accompanies many of the gold showings but not all. In addition, several arsenic-rich showings do not have high concentrations of gold. Copper is most abundant on the granitic South Islands in Great Slave Lake, but a string of copper-rich showings follows the main Proterozoic fault traces. Galena and sphalerite are commonly found together in the field and one would expect that the distribution patterns would be very similar. However, the single-element distribution plots show that the peak concentrations of lead and zinc are in distinct localities. Lead is concentrated at Ptarmigan Mine, Homer Lake, Clan Lake and east of Yellowknife Bay at Burwash Point. In contrast, zinc concentrations are low in the Clan Lake area and elevated at Crestaurum Mine and east of Walsh Lake/Yellowknife Bay. Silver displays a very unusual pattern with greatest concentration in an east-west band, from Ptarmigan Mine across the strike of the volcanic belt to Crestaurum Mine and David Lake. This zone of elevated silver crosscuts lithological units and known structures. Antimony and molybdenum show a similar pattern: the greatest concentration of antimony, is centred at Crestaurum Mine; molybdenum is also enriched at Crestaurum Mine, but the highest concentrations are near Ryan Lake, one kilometre north of Crestaurum Mine. The distribution of tungsten is dominated by concentrations in the northeast corner of the research area, near Sito and Sophia Lakes. Barium and iron are enriched in the sedimentary iron formations, but barium is also abundant in vuggy quartz veins, resulting in a widespread distribution with no single peak. Nickel and chrome peaks are associated with ultramafic intrusions near the Mon Mine and the Duck Lake Intrusive Sheet on the east side of Yellowknife Bay. There is an additional anomalous concentration of nickel near Sito Lake associated with massive arsenopyrite.

By using single-element and normalized bi-element spatial distribution plots to identify areas of anomalous concentrations, it is possible to gain a better understanding of regional zonation in the Yellowknife area than from the standard scatter diagrams.

BHP UTAH MINES LTD. ULU GOLD PROPERTY

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The ULU Property is approximately 530 km north-northeast of Yellowknife in the High Lake Volcanic Belt (HLVB) within the Archean Slave Structural Province, NWT, Canada. Twelve claims totalling 15 234 acres were staked by BHP-Utah Mines Ltd. in 1988 and 1989 based on anomalous gold results obtained from reconnaissance traversing.

ULU protects a lobe of supracrustal rocks on the western margin of the HLVB. This lobe is separated from the main part of the belt by a narrow granitic apophysis. The supracrustals comprise a sequence of basalts, greywackes and gabbroic sills, all folded into a 5-km-long (doubly plunging ?) anticlinal structure. Late-stage feldspar-porphyry, quartz-diorite and diabase dykes transect this sequence. The rocks exhibit a metamorphic grade to lower amphibolite.

Auriferous zones are near a north-trending fold axis which is traceable for 5 km. The largest zone known to date is the Flood Zone, which can be traced on surface for 400 m in a northwest direction near the core of the anticline. The principle zone is generally 2 m to 5 m thick with local thickening greater than 10 m and has been intersected at depths below 600 m. Increased thicknesses correspond to flexure points along the roughly tabular body. Lesser developed en echelon hangingwall and footwall zones have also been recognized. The Flood Zone is hosted by tholeiitic basalts with subordinate intercalated metasediments and gabbroic sills. The steeply dipping mineralized structure exhibits both brittle (breccia) and ductile (mineral segregation in shear banding) features. The development of both of these textures can be attributed to changes in the fluid pressure/temperature regime. Multiphase deformation is exhibited by rebrecciation and vein paragneiss.

The auriferous mineralization comprises intense silicification and accicular arsenopyrite development. Gold grains, typically 10-80 microns wide, are primarily found at arsenopyrite-quartz boundaries. The arsenopyrite constitutes approximately 5% of the zone as needle aggregates within quartz veins, fractures and as virtual complete replacement of brecciated basalt wallrock fragments. Accessory sulphide minerals include pyrrhotite, pyrite and minor chalcopyrite. Alteration minerals present include biotite, hornblende, actinolite-tremolite, potassium feldspar (microcline) and calcite with minor epidote (clinozoisite), tourmaline and sphene. Stockworked quartz-actinolite veins and biotite form an alteration envelope extending 2-5 m from the zone. This alteration halo is characterized by enrichment in potassium (biotite + microcline) and depletion of sodium (breakdown of plagioclase), which is consistent with classic Archean hydrothermal systems.

STRATABOUND CU, GRANITE-RELATED MO-U, AND FELSIC-VOLCANIC-HOSTED U AT DEVRIES LAKE, SOUTHERN GREAT BEAR MAGMATIC ZONE, NWT

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Metasiltstones of the Aphebian Snare Group and a younger felsic volcanic assemblage at DeVries Lake (86 C/7), have been deformed and intruded by granites of the approximately 1850-Ma-old Great Bear magmatic zone. The metasiltstones are part of a siliciclastic platform sequence that contains ferruginous cordierite-garnet beds and magnetite lenses, and host chalcopyrite-pyrite-rich beds and associated sulphide-rich veins at the **KOL** showing. The sulphides contain minor amounts of Au, Co and W. Minor folds here plunge gently to the north.

Granite-related veins occur in folded metasiltstones at the **NORI** prospect and contain molybdenite, uraninite/pitchblende, biotite, tourmaline and magnetite.

The felsic volcanic assemblage includes a pink porphyritic unit, characterized by abundant magnetite as disseminated grains and streaks as much as 10 cm long. It contains 20 to 100 ppm U, and in addition hosts uraninite/pitchblende veinlets at the **UGI** and **FXO** prospects. This uranium-magnetite association reflects a regional metallogenic characteristic of the southern Great Bear magmatic zone.

COMPUTER-BASED FIELD MAPPING: THE EXPERIENCE OF THE MINERAL INITIATIVES OFFICE

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Geologists of the Canada/NWT Mineral Development Agreement began computerization of mapping in 1988 with the purchase of laptop computers, digitizing tablets, AutoCAD drafting software and R:base database software. In 1989 linking software was purchased to connect R:base to AutoCAD for the automatic creation of geology maps. Initial efforts in linking the database and AutoCAD were unsuccessful because, i) the database was complex and required excessive time to enter the data, ii) the linking software was complex and difficult to use, and iii) the linking software contained program errors. At this time maps were created in AutoCAD and geological data was maintained in R:base but the two programs were not linked.

The initial period of experimentation demonstrated the need for a simple method of transferring data from a database to AutoCAD, and the need for a database to which data could be quickly added. Lotus 1-2-3 was selected as the new database because of its ease of use and its built-in macro language. Simple and descriptive codes were developed for all commonly recorded data. Only data that would be presented on final maps (e.g. structural measurements, rock types, and mineral occurrences) were incorporated into the database: descriptive text data was mainly eliminated. Macros were written in Lotus 1-2-3 to produce script files to transfer data from the database to AutoCAD. The current system operates as follows.

1. In the field, traverse data are entered into Lotus 1-2-3. Daily traverse data can be entered in 10 to 15 minutes freeing up geologists for other tasks.

2. In the office, station locations are transferred from field maps to previously digitized AutoCAD base maps. Station numbers and their associated UTM co-ordinates are then extracted from Autocad and merged with the Lotus 1-2-3 database.

3. Macros are run in Lotus 1-2-3 that produce script files from the field traverse data.

4. When the Lotus 1-2-3 generated script files are run in AutoCAD, symbols and associated text are inserted in their correct location and orientation on predefined layers within the AutoCAD drawing.

5. The resultant map requires some editing as symbols may conflict with hydrography or other symbols. Geological contacts, faults and other linear features are digitized separately.

This system allows data to be transferred from the database to AutoCAD. Although not as powerful as a Geographical Information Sysytem, specific information can be extracted from the database before the script-producing macros are executed. This open system can be adapted and improved to meet future mapping requirements. As an additional benefit, computerized mapping has helped to standardize symbol and AutoCAD layering conventions in the Mineral Initiatives Office.

GEOLOGICAL MAPPING IN THE HANIKAHIMAJUK LAKE AREA (86 I/2), NORTHWESTERN SLAVE PROVINCE, NWT

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During 1991 the Hanikahimajuk Lake area (NTS 86 I/2) was mapped at 1:20 000 under the EM&PR/DIAND Mineral Initiatives program. Hanikahimajuk Lake, informally known as Amooga Booga Lake, is 425 km north of Yellowknife. The map area is at the southern end of a northeast-trending supracrustal belt along the eastern shore of Napaktulik (Takijuaq) Lake, and is possibly continuous with the Point Lake belt to the south. This project was undertaken in conjunction with regional 1:50 000 DIAND-Geology mapping of the western margin of the Slave Province in 86 I.

Rhyolite, dacite and related fragmental rocks and tuffs are the most abundant volcanic rocks. Felsic fragmental rocks have textures indicative of sedimentary reworking. Mafic to intermediate massive and pillowed flows are less common and locally display amygdaloidal, plagioclase porphyritic and variolitic textures. Dark green to black laminated siltstone-mudstone and minor interbedded mafic flows are common along the western edge of the supracrustal belt. A small outcrop of iron formation is at the northeast end of Hanikahimajuk Lake. A coarse-grained package of clastic rocks including quartz wackes and arenites, polymictic and quartz-pebble-dominated conglomerates occupies the northwest margin of the map area. Supracrustal rocks are bordered and partly intruded by a mixed intrusive unit composed of gabbro, leucogabbro, quartz monzonite and tonalite. Northwest-trending ultramafic dykes, up to 20 m wide cut the mixed intrusive unit.

Supracrustal rocks are bordered to the west by the Tak Granite (Hyde, 1976), herein called the Tak Complex. This complex comprises strongly foliated orbicular granite, foliated granite to granodiorite, para- and orthogneiss. Contorted migmatitic hornblende gneiss at the south end of Napaktulik Lake may be basement remnants. To the north and south are diorite stocks locally bordered by amphibolites and containing fine-grained mafic xenoliths. A red-weathering granite termed the Rim Granite (Hyde, 1976) lies between the supracrustal rocks and southern diorite stock. To the east in 86 I/1 supracrustal rocks are bordered by the Rockinghorse Batholith (Bostock, 1976). Simple quartz-kspar pegmatites cut the supracrustal rocks, the mixed intrusive unit, the Tak Complex and the diorite stocks. Northeast-trending quartz-kspar-muscovite pegmatite dykes cut supracrustal rocks along the western belt contact. West-northwest to northwest-trending diabase dykes cut all previously described lithologies.

Polyphase deformation, late faulting, and the general lack of recognizable bedding and top indicators in felsic volcanic rocks complicates stratigraphic reconstruction of the belt. Younging directions from graded bedding and crossbedding in arenites, and from pillowed flows suggests the northwest portion of the belt tops towards the west. The composition of clasts in the conglomerates indicates sedimentation occurred after volcanism, mafic plutonism, and the emplacement of high-level felsic intrusions. The regional foliation trends northeast, and commonly dips to the east. Within felsic volcanic rocks identification of folds related to the regional foliation is complicated by the paucity of recognizable bedding. However, southwest of Hanikahimajuk Lake, bedding-cleavage intersections suggest the presence of a major northeast-trending isoclinal fold. Refolding of the regional foliation about north-northwest to north-trending fold axes has locally produced a crenulation cleavage. Shearing fabrics are predominantly northeast-trending. A northeast-trending fault structure is discontinuously exposed for 10 km in meta-sedimentary rocks in the western portion of the belt. The fault is marked by hematization, quartz veining and the introduction of disseminated pyrite. Northwest-trending faults truncate units within the belt and offset belt contacts.

The H-10 (500 000 tons 5% Cu, 3.5% Zn and 31 g/t Ag: National Mineral Inventory) and H-41 massive sulphide deposits (320 000 tons 1.57% Cu, 4.12% Zn and 16 g/t Ag: National Mineral Inventory) and smaller H-461 and H-462 showings were discovered and drilled in the mid-1970's by Texasgulf Incorporated. Numerous sulphide gossans containing disseminated chalcopyrite are developed in felsic volcanic rocks. Anomalous concentrations of gold detected in assay samples include 960 ppb Au (arsenopyrite bearing quartz vein), 840 ppb Au (H-10 massive sulphide deposit), 364 ppb Au (quartz-pebble conglomerate with quartz veins), 134 ppb Au (pyritiferous shear zone in metasedimentary rocks), and 71 ppb Au (quartz vein in iron-formation). A small gossan in ultramafic rocks had 540 ppb Pt; serpentinized zones of ultramafic dykes may be suitable for carvingstone.

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ARCHEAN GOLD MINERALIZATION: DISTRICT OF KEEWATIN

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The majority of gold showings in the Keewatin District are in the Kaminak supracrustal domain or in minor associated supracrustal sequences. They occur in host rocks which have been metamorphosed to greenschist or amphibolite facies and are associated with disseminations or vein aggregates of simple sulphide assemblages in the following environments:

(a) minor structures disrupting magnetite-chert ± hornblende and grunerite iron formation (IF) near structural contacts between mafic or ultramafic volcanic units and wacke-pelite units, or within volcanic or sedimentary sequences.

(b) cherty IF or quartz-chlorite beds within wacke units, or at stratigraphic contacts between mafic volcanic and sedimentary rocks.

(c) bedded Fe-carbonate-chert ± magnetite IF within wacke-pelite or mafic volcanic sequences.

(d) veins of quartz-carbonate ± tourmaline, with or without Fe-carbonate wall-rock alteration, near sheared lithological contacts (volcanic-sedimentary or mafic volcanic-felsic volcanic), or within sheared mafic or felsic volcanic units associated with small intrusive plugs of gabbro or rhyodacite porphyry.

(e) veins of quartz or quartz-Fe-carbonate on the margins of brittly fractured plugs of gabbro or diorite.

GEOLOGY OF THE NERCO CON MINE, YELLOWKNIFE NWT

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From the first gold pour in the NWT in 1938 to January 1, 1991 the NERCO-Con Mine has produced 7 770 000 tonnes (8 565 000 tons) of ore at a grade of 18.5 g/t (0.54 oz/ton) containing 143 938 kg (4 627 800 ounces) of gold. Current reserves are 3 111 000 tonnes (3 429 000 tons) at a grade of 10.3 g/t (0.30 oz/ton) containing 31 523 kg (1 013 500 ounces). Ore has been produced from 3 north-trending, west-dipping shear zones that transect the northeast-striking Kam Group. All of the production has come from an area where the shears coincide with the intersection of pillowed to massive basalt of the Yellowknife Bay Formation and an east-west trending thermal corridor defined by granite plugs, dykes and related breccia bodies.

The Con and Campbell Shear Zones are curviplanar chlorite-sericite-carbonate-schist domains with widths up to 30 m (100 ft) and 150 m (500 ft) respectively. In addition, on surface they correspond to the hornblende-epidote and the epidote-chlorite isograds of the Western Granodiorite Metamorphic aureole. The Rycon-Negus Shear Zones are narrower with widths up to 2.4 m (8 ft), and occur between and at a slight angle to the Con and Campbell Zones.

Displacement in the shear zones is dominated by reverse movement as indicated by folded quartz veins and lineation in the schist. There is also earlier right-lateral movement across the Campbell Shear of at least 600 m (2000 ft) indicated by offset of stratigraphy. The last offset is manifest by small offsets of Proterozoic diabase dykes which themselves cut the shears. Shears are offset by several steeply dipping Proterozoic faults. Major Proterozoic faults in the mine area are the north-trending West Bay and Pud Faults and the northeast-trending bedding-parallel Negus Fault.

Gold occurs in steeply dipping, foliation-parallel, sulphide-enriched quartz-ankerite veins that are enclosed in variably sized sericite-carbonate envelopes. Ore in the Con and Campbell Shears is refractory to a depth of 940 m (3100 ft), while ore in the Rycon-Negus Shears was reported to be free milling.

Ore zones may have formed when metamorphic fluids moving outward from the Western Granodiorite were channeled into deep-seated faults. Gold and accessory minerals were precipitated from ascending fluids in response to changing temperature, pressure and fluid chemistry. Later remobilizaton of gold occurred during reverse movement on the shears.

GEOTECTONIC CONSIDERATIONS IN DIAMOND EXPLORATION

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Although it is well-known that diamond-bearing kimberlites and lamproites occur primarily on Precambrian cratons, particularly on those underlain by rocks of Archean age (this is often referred to as Clifford's Rule), hypotheses explaining this phenomenon have not provided a rigorous theoretical base for area selection in diamond exploration. One of the major problems was the general assumption that exploration for kimberlite and lamproite diamonds consists essentially of searching for the diamondiferous host rocks on old cratons, and that efforts to establish exploration models need focus only on understanding the larger-scale geotectonic and structural controls of kimberlite and lamproite distribution. Only after it was recognized that most diamonds in kimberlites and lamproites probably do not belong to the igneous mineral assemblage of their hostrocks, but represent xenocrysts, has it become obvious that the understanding of the geotectonic environment of diamond formation is an entirely separate, but equally important problem. In this paper, the geotectonic foundations of a diamond exploration model are discussed which includes the following three steps:

1. Prediction of regions under which diamonds may have formed.

2. Selection of those areas where diamonds may have survived to be sampled by younger kimberlites or lamproites.

3. Establishment of regional tectonic and local structural controls for the emplacement of kimberlites, lamproites, or related rocks in the appropriate areas.

In the first step, the diamond potential of a craton is equated with the presence or absence of relatively low-density and low-temperature mantle roots, thought to represent the most plausible environment of diamond formation. Such mantle roots have formed preferentially in the early Archean, and

their survival under Archean cratons can be recognized by characteristic geochemical and geophysical signatures. For step two, examples from Brazil, southern Africa, and Australia are used to illustrate the concept of "mantle-root-friendly" and "mantle-root destructive" structures and events that can be used to evaluate how the post-diamond-formation tectonic history of the craton may have affected the diamond potential of the mantle root. Applications to North American Archean cratons (Slave and Wyoming provinces) are discussed. During area selection for kimberlite and lamproite search in prospective areas (step three), a careful study of the tectonic history should be integrated with traditional search methods to identify regional and local "mantle-root-friendly" structures that may have provided pathways for the diamondiferous host rocks.

GEOCHRONOLOGY AND STRUCTURAL GEOLOGY OF THE EARLY PROTEROZOIC FOXE-RINKIAN OROGEN, BAFFIN ISLAND, NWT

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The Foxe-Rinkian orogen is composed of Archean and Early Proterozoic rocks that were deformed and metamorphosed during the Hudsonian orogeny. The orogen extends northeast from south Melville Peninsula (Foxe portion of the orogen) to west Greenland (Rinkian portion), where it disappears beneath the Inland Ice. A lower group of platformal sedimentary rocks and an upper group of basinal sedimentary rocks are recognized along the exposed length of the orogen. In central Baffin Island, the platformal rocks were deposited on an Archean granitic basement complex, and detrital zircons from the basal quartzite formation are as old as 2.83 Ga. A sequence of intermediate to basic sills and submarine volcanic rocks occurs above the platformal sequence, and a U-Pb zircon age of 1883.3 ± 4.7 Ma obtained from a diorite sill indicates the time of basin development.

Hudsonian deformation in central Baffin Island was in a second phase when anatectic sills and dykes intruded the paragneisses at 1810 Ma. Penetrative deformation ended before intrusion of granitic pegmatite dykes at 1804 Ma.

The age dates, in conjunction with structural data analysis, may be used to model the tectonic development of the orogen.

ON THE ECONOMIC POTENTIAL OF SOUTH-CENTRAL WOPMAY OROGEN

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Mesothermal gold mineralization is not limited to Archean terrains. This is clear from theoretical considerations and from the occurrence of mesothermal gold deposits in Mesozoic and Cenozoic rocks of the circum-Pacific region. There are two basic requirements for such mineralization. The first is a hydrothermal system, driven by some combination of prograde metamorphism, advective magmatic heating, and a mountain belt to provide a hydraulic head. The second is a localized site for gold precipitation having the chemical potential to break down dissolved gold complexes (e.g. iron formation or carbonaceous black shale). These requirements are met in south-central Wopmay orogen and the occurrence there of gold showings at Norris Lake (64°27'N, 115°45'W) indicates that metasediments of the 1.9 Ga Snare Group in the Emile River belt are most prospective for gold.

In the early 1970's, a major lake-sediment Zn-Pb-Cu anomaly in the medial zone of northern Wopmay orogen was identified by the National Geochemical Reconnaissance Program. A potential source of the anomaly is a sequence of gossanous pelitic, psammitic, bimodal metavolcanic, and minor carbonate rocks assigned to the Grant Group. Recent isotopic and geologic evidence indicates that the Grant Group is genetically distinct from the continental terrace wedge (Coronation Supergroup) of eastern Wopmay orogen. It was apparently deposited on a tectonically extending magmatic arc (Hottah terrane) at 1.90 Ga, just prior to the collision of the arc with the Slave province continental margin at about 1.88 Ga. As such, the Grant Group is a favourable host for sedex or VMS mineralization.

Existing maps of south-central Wopmay orogen (Lord, 1942) are inadequate to distinguish rocks of the Grant Group and its basement (Hottah terrane) from those of the continental terrane wedge (Snare Group of the Emile River belt) and its basement (Slave province). The first-order task that remains is to delineate the two basement-cover domains (i.e. terranes), which differ in fundamental tectonic setting and potential mineralization, and the refolded suture zone along which they are tectonically superposed.

1:5M AND 1:1M GEOLOGIC MAPS OF THE NORTHERN CANADIAN SHIELD

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A new 1:5M scale geologic map of the Slave, Churchill and Bear provinces of the Canadian shield was compiled in September 1991 for inclusion in the DNAG Geologic Map of North America. The display map uses a Lambert Conformal-Conic base and was assembled from a series of 1:1M scale maps compiled earlier from original sources. The 1:5M map contains 52 colour units distributed in a matrix of 10 age divisions and 16 lithologic divisions. The basic colour scheme for supracrustal and plutonic rocks respectively is: 4.0-2.5 Ga, blue and orange; 2.5-1.6 Ga, green and red; 1.6-0.9 Ga, yellow-/brown and rose/violet; 0.9-0.54 Ga, grey. The 1:1M scale source maps will be available for consultation.

MEADOWBANK PROJECT UPDATE

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Lucky Eagle Mines Ltd. (wholly owned subsidiary of Agnico-Eagle Mines Ltd.) and Agnico-Eagle Mines Ltd. are presently participating under an option agreement by spending $3.5 million to earn a 55% interest in the project from joint venture partners, Comaplex Minerals Corp. and Asamera Minerals Inc. who presently hold 40% and 60% respectively.

Lucky Eagle is currently in the third year of exploration on the "Third Portage Occurrence". Assay results from definition

drilling, employing a 20 metre x 40 metre grid pattern, indicate several economic zones of gold mineralization hosted in sulphidized magnetite iron formation spanning a strike length of 500 m. Drill cross sections show that the mineralization thickens and gold tenure increases toward the core of a shallow dipping, south plunging fold structure where sulphidization, silicification, and shearing are most intense. Out of 40 drill holes, twenty contain significant weighted assays averaging greater than 10 grams/tonne over a 3 metre core length.

The design of the 1991 exploration program evolved from a synthesis of previous geological mapping, diamond drilling, and ground geophysics integrated with recently acquired GSC airborne data in order to select geological environments similar in structural style to the Third Portage Occurrence.

In preparation for the field programs, a series of magnetic vertical gradient maps, image processing and enhancements were produced at scales of 1:50 000 and 1:20 000 from the GSC data set (320 km^2 coverage).

A geophysical program employing magnetics, VLF and a large-loop time-domain system (UTEM), was conducted on a 6 km^2 grid area covering strong magnetic-gradient domains south of Third Portage.

A 24-hole (3992 m) diamond drill program focused on extensional fence drilling in the vicinity of Third Portage and exploratory drilling on new targets south and west of Third Portage. Exploration drilling on "Goose Island" confirmed the presence of encouraging gold mineralization over a 225 metre strike length, located one kilometre south of the Third Portage Showing.

The mineralization is hosted in sulphidized iron formation containing intervals of pyrrhotite and pyrite ranging from 10% to 25%. These concentrations replace layer parallel magnetite-chert bands and occur in deformed banding altered by quartz veining and silicification.

A mylonitic shear zone was intersected and explored in six locations on the west flank of Third Portage Lake over a 4 kilometre length. In the north, the shear zone is typified by brittle features such as fault gouge, breccia, and quartz veins, while farther south the development of extensive mylonitization is characterized by a cohesive, laminated, schistose to blastomylonitic fabric with associated alteration; namely hematization, quartz/jasperoid/calcite/epidote veining, breccias and feldspar porphyry dykes. Anomalous gold assays were obtained from zones of massive quartz/jasperoid veining and breccias.

A spatial and structural relationship with respect to auriferous, sulphidized iron formations and a major mylonite shear structure is evident from geologic mapping, geophysics and diamond drilling.

GEOLOGY OF PART OF THE NAPAKTULIK LAKE AREA (86I), SLAVE STRUCTURAL PROVINCE: PRELIMINARY INVESTIGATION

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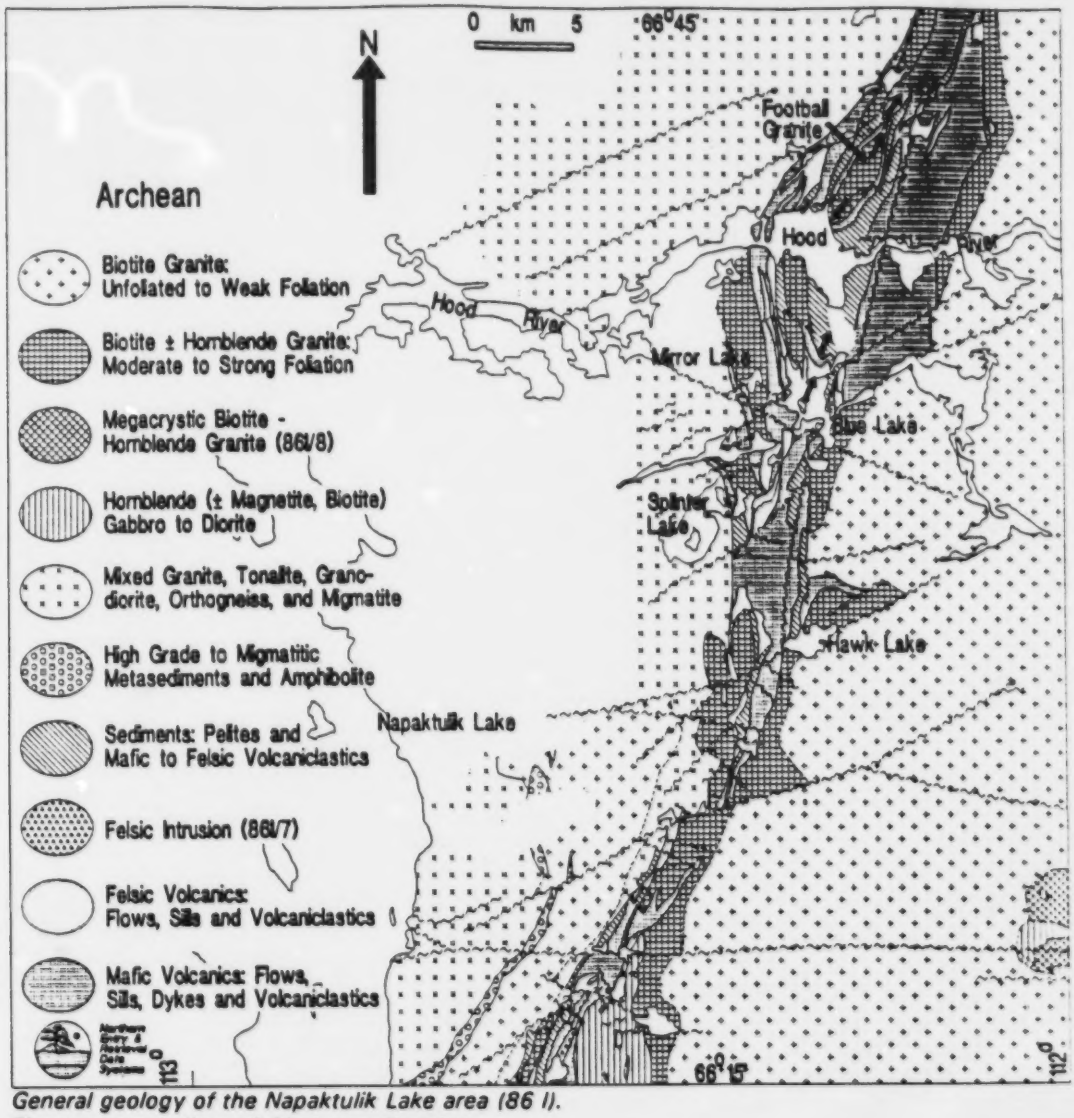
Napaktulik (formerly Takijuq) Lake is along the boundary between the Archean Slave and Proterozoic Bear Structural Provinces, about 300 miles NNW of Yellowknife. A four-year 1:30 000 scale mapping project was initiated in the Napaktulik Lake area in 1991. During the first field season 86 I/8 & 9 and parts of 86 I/7 & 10 were mapped. The area was previously mapped by Craig *et al.* (1960); Ballinderry Exploration and Noranda Exploration Companies examined the Blue Lake and Hawk Lake gossans in the 1970's.

The area is underlain by a NNE-trending supracrustal belt dominated by low to medium metamorphic grade volcanic and volcaniclastic rocks (Figure). The abundance of bedding-parallel or subparallel faults complicates stratigraphic reconstructions. Basaltic, volcaniclastic and gabbroic rocks form one or possibly two mafic volcanic sequences. The intervening, less voluminous, felsic sequence comprises rhyolitic/dacitic flows, sills and volcaniclastic rocks. Pelites overlie volcanic rocks in the Blue Lake area, but elsewhere are interbedded with felsic or mafic volcaniclastic rocks. Pelites locally contain sulphide-rich garnet amphibolite beds. Calcareous sediments are found at the mafic volcanic-sediment interface and within the mafic volcanic pile.

Thickness of the belt varies from less than 1 km to greater than 8 km. Where the belt is narrow the supracrustal rocks are highly deformed and primary features are not apparent. Conversely, where the belt is wider primary features, such as basaltic pillows and graded sedimentary beds, are more identifiable. Rocks within the belt display a predominant, bedding-parallel fabric (S_{main}). Porphyroblast growth (e.g. cordierite and amphibole) was either concurrent or predated S_{main} development. S_{main} was subsequently deformed into mesoscopic, open to tight folds about NW- and NE-trending axial traces (F_{NW} and F_{NE}) plunging both to the north and south. Temporal relationships between these secondary fold orientations remain to be determined. The termination of some lithologic units can be attributed to reversals in fold plunge direction. Macroscopic F_{NE} folds can be traced from the Blue Lake area to north of the Hood River, whereas macroscopic F_{NW} folds were not identified.

West of the belt is a mixed unit consisting of biotite ± hornblende tonalite and granodiorite, tonalitic to granitic gneiss and high-grade supracrustal rocks, all variably intruded by biotite granite and pegmatite (Figure). East of the belt lies an extensive granitic terrane of mainly unfoliated biotite granite (Figure). This granite is tentatively correlated with one of the youngest intrusive phases recognized in the Contwoyto Lake (King *et al.*, 1988) and Kathawachaga Lake (Jackson, 1989) areas. Adjacent to and within the supracrustal belt, granitic phases that are potentially equivalent to the eastern granite are strongly foliated, and some experienced the same folding event(s) as the supracrustals. Notably, the Football granite is interpreted as a doubly-plunging F_{NE} antiform.



General geology of the Napaktulik Lake area (86 I).
Short arrows indicate fold plunge direction.

Much of the penetrative deformation that affected the Napaktulik Lake supracrustal and granitic rocks is presumed to be Archean. However, proximity to the Wopmay Orogen suggests that a Proterozoic tectonic overprint is possible. For instance, the structural culmination of the Football granite may be an Archean feature that was modified by NNE-trending Calderian and NE-trending Tree River folds (Hoffman *et al.*, 1984; King *et al.*, 1988).

The supracrustal belt was explored for volcanogenic massive sulphides (VMS) after discovery of the Cu-Zn-Ag deposits near Amooga Booga Lake (Hood #10 and #41). Spectacular gossans marking massive sulphide zones (MSZ) are common throughout the belt, but are concentrated in the Hawk Lake, Blue Lake and Hood River areas (Figure). MSZ at felsic-mafic volcanic interfaces or at sediment-volcanic contacts are commonly associated with thin calcareous units. Pyrite, pyrrhotite and chalcopyrite dominate the sulphide mineralogy of MSZ. Many MSZ contain well-rounded quartz ± lithic ± sulphide clasts suggestive of either post- or syndepositional deformation. Analyzed samples of MSZ yielded elevated Zn and Cu (e.g. 2200 ppm Zn; 1600 ppm Cu), but no appreciable concentrations of Ag, Pb or Au.

As previous exploration efforts focused primarily on VMS deposits, part of the aim of the 1991 field season was to explore the area for any other mineral concentrations. Our assay results indicate that: a) Cu, Zn, Pb, Cr, As and Au are locally elevated in shear zone-related quartz-carbonate veins; b) some sheared mafic volcanic rocks yield elevated Zn, Cu, Ni and Cr and c) the area has arsenopyrite- and possibly fuchsite-related gold mineralization: samples with significant gold concentrations (81 to 2600 ppb Au) also contain anomalous As (1800 ppm to 18.4% As) and up to 966 ppm Cr.

Several new arsenopyrite showings were recorded, mainly within felsic rocks or pelitic to graphitic sediments. Arsenopyrite concentrations are spatially associated with NE-plunging folds at Blue Lake (Figure). In one example, near

the felsic-mafic volcanic contact and adjacent to a MSZ, massive arsenopyrite veins vary from 1 to 20 cm in width and have a discontinuous strike-length of over 10 m. The veins are hosted by an intensely deformed quartz-rich and quartz vein-rich rock with trace amounts of chrome-rich mica. Two grab samples from this zone assayed 2600 and 1680 ppb Au and contain anomalous Cr concentrations.

Mapping in 1992 will continue to the north and west of the area mapped in 1991. This work, in association with geochemical and geochronological studies, in part will be aimed toward defining the character and extent of Proterozoic deformation and further exploring the economic potential of the area.

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REVISED STRATIGRAPHY AND STRUCTURE OF PROTEROZOIC TO CRETACEOUS STRATA IN AND AROUND THE BROCK INLIER, NTS 97A AND 97D: SOME IMPLICATIONS FOR MINERAL AND ENERGY RESOURCE ASSESSMENT OF THE PROPOSED BLUENOSE LAKE NATIONAL PARK, NWT

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A geological and geochemical survey of the proposed Bluenose Lake national park is one of a number of studies (e.g. archeology, biology, anthropology) being done to provide information for public consultations. The results of this resource assessment are due for public release early in 1992. Geological findings reported here have at least two regional implications. (1) We suggest that Proterozoic sedimentation in the area of the Brock Inlier was more basinal (but still platformal) than previously thought, and thus Proterozoic strata here are less prospective for copper than more shoreward settings elsewhere in Amundsen Embayment. (2) We recognize a varied sequence of deformations which might contribute to understanding of seismic records and therefore hydrocarbon potential in the adjacent Anderson Plain.

The Brock Inlier exposes an unmetamorphosed late Proterozoic sedimentary sequence which is overall gently dipping with local steep dips and faults (see below). The oldest map-unit, P1, is an estimated 900 m of drab grey shale and siltstone containing a variety of concretions. It correlates litho-stratigraphically with the basal member of the Glenelg Formation on Victoria Island, and with map-units 19 to 21 in the Rae Group. Its equivalent is not exposed in Mackenzie Mountains.

P1 is gradationally overlain by map-unit P2, comprising up to 240 m of grey cherty dolostone with stacked flat-chip intraformational breccia, and stratiform, bulbous and columnar stromatolites. The stromatolites form biostromes with little growth relief. P2 records flat sabkha-like shoreline sedimentation. It corresponds to the middle cherty dolostone member of the Glenelg Formation on Victoria Island, and to map-unit H1 of the Mackenzie Mountains Supergroup.

Map-Unit P3 is a coarsening-upward quartz arenite sequence, estimated to be 450 m thick and interpreted as a northwesterly prograding alluvial-deltaic braid plain. In southern Brock Inlier the dolostones (P2) are abruptly overlain by 2 to 10 m of deep red flaggy fine sandstone and siltstone with shale interbeds and local glauconite. These fine clastic rocks grade upward to typically pale red quartz arenites that form the bulk of P3. North of the Brock River canyon, however, we found at least several metres of black, green and red shales between the dolostone and sandstone which suggest a more basinal setting. Correlative Shaler Group strata even farther north, at the southern tip of Banks Island, include 110 m of shale and siltstone between the sandstones and the underlying dolostones. Correlatives of P3 to the southeast are thinner (Rae Group Unit 23 = 90 m.) whereas to the southwest they aggregate more than 2.5 km (Tsezotene shales and siltstones >1200 m and Katherine quartz arenites K1 to K5 >1300 m).

Previous paleogeographic models have shown the Brock Inlier as occupying the east flank of the Great Bear Arch, suggesting proximity to a northwesterly trending paleo-shoreline in this area. The above thickness and paleocurrent data are more compatible with a northeasterly trending paleo-shoreline. We therefore interpret the depositional setting of the Brock Inlier as relatively basinal compared to the Rae Group and eastern Victoria Island where the arenites abruptly overlie the dolostones and are thinner. The Great Bear "Arch" appears to have been more of a shoulder facing northwesterly into the Amundsen Embayment and southwesterly into the Cordilleran basin rather than an active arch separating the two basins during P3 sedimentation. A more complete comparison of the P2-P3 sequence with equivalents in the Rae Group and eastern Shaler Group is being prepared.

Unit P3 was investigated as a possible host for disseminated copper sulphides because it contains minor pyrite and gossans at its base in Brock River Canyon, and its thick red-bed sequence is characteristic of the stratabound sediment-hosted copper deposit model. Examination and trace element analysis of hand samples, stream silts and soil samples from the P2-P3 contact at nearly a dozen localities has located minor copper (up to 180 ppm) at one site in the Brock River canyon.

Map-unit P4 was previously undivided and of uncertain correlation. We have determined that it comprises four members (for convenience labelled here as P4 A-D) which correlate with members of the Shaler Group on Victoria Island, and with subdivisions of the Mackenzie Mountains Supergroup. The basal P4A member (5 to >50 m) comprises a double layer of bright orange-weathering branching stromatolitic dolostone (cf. Inzeria biostromes) separated and overlain by black and glauconitic green shale. This "orange stromatolite" and its sideritic character have been correlated from northern Victoria Island, where a single biostrome marks the top of the Glenelg Formation, to the Mackenzie Mountains, where a double biostrome is contained in shales of unit K6 of the Katherine Group. In Brock Inlier the P4A stromatolite has a relatively basinal appearance, particularly toward the north where it is greyish tan weathering, draped by black shale and exhibits abrupt lateral facies changes to nodular laminated dololutite. Component bioherm edges trend north-northwesterly. These facies and orientations support the basin configuration suggested above.

The overlying 50-100 m clastic member, P4B, coarsens upward from glauconitic shale to quartz arenite and grades into arenaceous calcarenite. This marine sandstone is a key marker, separating P4A from the gradationally overlying tan dolostone and grey limestone member (P4C, estimated 500 m) which is characterized by oolitic grainstones and cf. Baicalia stromatolites. The top member, P4D, comprises at least 100 m of laminated grey dolomite, with sub-units of marine quartzarenite, silicified oolite and a finely laminated stromatolite, cf. Acaciella. The newly recognized P4B,C,D members correlate lithostratigraphically with the Reynolds Point Formation on Victoria Island and with the upper Katherine Group (K7) to the lower Little Dal Group in Mackenzie Mountains.

P5, the youngest Proterozoic sedimentary unit, comprises at least 150 m of interbedded gypsum, fine-grained red clastic rocks and buff stromatolitic dolomite. P5 corresponds to the Minto Inlet Formation of Victoria Island and the Gypsum Formation of the Mackenzie Mountains. Gently dipping P5 strata are bevelled by the sub-Cambrian unconformity in the south-centre and northeast parts of the Brock Inlier. On the east and west sides of the Inlier, the Paleozoic strata rest on P4. This implies gentle faulting and/or folding before Cambrian time, much like on Victoria Island.

Map-unit P6 is diabase sills and dykes of the Franklin mafic event. These have been dated on Victoria Island at 723 ± 3 Ma by the U-Pb method on badellyite. Carbonates intruded by these diabases are locally serpentinized and chloritized. Some of these altered rocks are being evaluated for carving-stone potential.

On the east side of Brock Inlier, a previously mapped westward-directed thrust or high-angle reverse fault juxtaposes P3-P4 on vertical Cambrian-Ordovician strata, and carries an east-to-west onlap unconformity with Devonian carbonates resting successively on Ordovician, Cambrian and P4 strata. The sub-Devonian unconformity is folded along northwesterly axes. This and nearby thrust/reverse faults were therefore active during Devonian time, as well as later during the Cretaceous (?). The reverse fault trends about 320° into the northern part of Brock Inlier, but dies out to the south into a series of tight to open 130°- to 150°-trending folds in Paleozoic rocks. A similar fault affects P3 and P4 strata from Brock River Canyon south to the Little Hornaday River. Open east-west folds intersecting the northwesterly folds generate dome-and-asin patterns in both Proterozoic and overlying Paleozoic strata. Southeasterly trending normal faults cut obliquely across the contractional faults, and have throws from 100's to 1000's of metres. Patches of Cretaceous (?) boulder conglomerates dominated by local rock types are preserved adjacent to some of the normal faults. Consideration of the above structures may help to interpret seismic records under Anderson Plain.

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GEOLOGICAL REASSESSMENT IN PARTS OF THE LAUGHLAND LAKE AREA (PRINCE ALBERT GROUP), NTS 56K SE, FOR MINERAL AND ENERGY RESOURCE ASSESSMENT OF THE PROPOSED WAGER BAY NATIONAL PARK

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Field work in 1991 began a two-year geological and geochemical survey of extensions to the proposed Wager Bay national park. Most of the proposed terrestrial portion of the park was assessed in GSC Open File 2351, but proposals to include the headwaters of the Brown River system and the marine waters of Wager Bay have necessitated this additional survey as one part of the park establishment process. Four geological entities were evaluated west of 92° in 1991, founded on regional geology published in GSC Bulletin 337.

1: The Laughland Lake anorthosite complex comprises a large volume of calcic and locally layered anorthosite with a narrow, thinly layered border phase of leucogabbro and gabbro. Other, coarser-grained amphibolite bodies within the adjacent Brown River gneiss and Prince Albert Group appear to be lenticular, shear-bounded metagabbro dykes.

2: The contact between the tonalitic Brown River Gneiss and the granitic Walker Lake Gneiss trends northerly at about 92°05'W. To the west, northeasterly fabrics dominate in tonalites which contain mafic, semipelitic and iron-formation lenses (fold keels or xenoliths?), and are intruded by sub-parallel sheets of K-feldspar-porphyritic granite gneiss (A' granites). A newly recognized belt of Prince Albert Group biotite schist and quartzite flanks an A' granite sheet along the southeastern margin of the study area. To the east, the strongly foliated gneisses are intruded at high angles by, and constitute polygonal blocks (roof pendants?) within, weakly to non-foliated, medium to fine-grained, fluorite-magnetite, pink granite.

3: The central, north-trending belt of komatiites is bounded by northerly trending faults which record both brittle and ductile movement. Newly documented leucocratic to melanocratic mylonites and tectonic melanges which separate the komatiites from bounding Brown River gneisses were previously interpreted as metasedimentary rocks. The faults have limited horizontal displacement (linear aeromagnetic highs representing iron-formations are not offset), and include

some vertical displacement (metamorphic grades locally differ on opposite sides of the faults). Within the komatiites, spinifex texture is well developed in flow tops, all flows are tabular, and flow thicknesses range from decimetres to several metres. The lack of metasedimentary rocks and the style of flows in this central komatiites belt suggest that the lavas here were erupted directly through basement gneisses into a subaerial environment. The southern and northern margins of the central komatiite belt, and komatiites elsewhere in the Prince Albert Group are, however, interdigitated with quartzites and iron-formations. Gossans associated with the komatiites were observed only where they are interdigitated with metasedimentary rocks, outside of the proposed park area.

4: In the western part of the study area, Quartzite Hill exposes a type II interference pattern resulting from refolding of a northerly isoclinal syncline by open, 070°/vertical kink folds. A number of trough cross beds provide younging directions in a fining-and-thinning-upward sequence at the core of this syncline. Adjacent to the 2 x 12 km Quartzite Hill, lack of younging criteria leaves open the possibilities of structural and/or stratigraphic repetition of thinner belts of quartzites and siltstones separated by meta-mafic volcanic rocks (basaltic komatiites?) with local gossans.

Geochemical analyses are being obtained for samples collected from gossans developed on disseminated pyrite and pyrrhotite in granite gneisses, amphibolites (metavolcanics), quartzites, iron formations and mylonites. In GSC Bulletin 337, minor chalcopyrite was reported in komatiites and gabbros, rare molybdenite in sphene-bearing granitic gneiss, and minor arsenopyrite in a small "high level" granitic pluton. Archived samples of these showings are being investigated for possible re-analysis.

Acknowledgement: This project is jointly funded by DIAND, GSC and the Canadian Parks Service.

GEOLOGY AND MINERAL POTENTIAL OF THE CAMSELL LAKE AREA (PARTS OF 75 M/6,10,11)

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The Camsell Lake area, in the southern Slave Province, is approximately 200 km northeast of Yellowknife. During 1991 the area was mapped at a scale of 1:50 000 as part of the EM&PR/DIAND Mineral Initiatives. The map area is underlain by remnants of an over 5 km thick, northwesterly-younging monoclinal succession comprising Yellowknife Supergroup volcanic and sedimentary strata. The succession includes the northeasterly- to north-northeasterly trending Camsell Lake Belt (CLB), a narrow, 65 km long volcanic belt extending from Lac Sans-disant, southwest of Camsell Lake, to the eastern margin of the map area.

The volcanic portion of the succession is approximately 2.5 km thick at its widest point. Massive and pillowed basalt, flow breccia, mafic schists, and rare argillaceous interflow sediments are preserved. Mafic flows, commonly separated by thin (< 2 m thick) pillow breccia or flow-top breccia units, are typically 5-10 m thick; massive flows predominate over pillowed flows towards the base of the succession. Basalts are commonly amygdaloidal and locally plagioclase porphyritic and variolitic. The volcanic rocks are conformably overlain by medial to distal turbidites represented by thin- to moderately-bedded, fine-grained graywackes grading to planar and cross-laminated siltstones and mudstones. The upward volcanic-sedimentary transition is gradational with several volcanic units isolated within the lower sedimentary strata.

The succession is invaded by three elongate glomeroporphyritic leucogabbro/gabbro stocks, numerous gabbro sills and rare leucogabbro sills. All three stocks and most of the sills are confined to the volcanic portion of the succession; gabbro sills account for 30-40% by area of the rock near the base of succession. The stocks mainly consist of leucogabbro with a composition approaching anorthosite and characterized by 2-4 cm plagioclase glomerocrysts. A more-mafic magmatic phase in the leucogabbro is represented by pods and small dykes of gabbro. A magmatic relationship between the sills and stocks is indicated by several porphyritic gabbro sills bearing rounded fragments of glomeroporphyritic leucogabbro.

Granitic intrusions include dykes and a small stock of melanocratic granodiorite, biotite-hornblende granite batholiths and dykes, and muscovite-granodiorite dykes. The melanocratic granodiorite, pre-dating the other intrusions, bears a regional northeast to north-northeast striking foliation (S_1) and is distinguished by hornblende phenocrysts and rare quartz phenocrysts. The batholiths bordering the southern edge of the CLB and truncating the succession to the east and north, comprise homogeneous biotite (± hornblende) granite with rare K-spar porphyritic and pegmatitic phases. The contact with the northern batholith is irregular and gradational with numerous sheets of biotite granite invading adjacent sedimentary strata. The granite commonly displays a weak to moderate biotite foliation possibly representing S_1. The biotite-hornblende granite is post-dated by muscovite-granodiorite dykes and related pegmatite dykes which tend to be concentrated in metasediments near the northern batholith contacts. All rocks are intruded by north-northwesterly and northeasterly trending diabase dykes.

Polyphase deformation is represented by three tectonic fabrics: S_1, a regionally pervasive bedding-parallel cleavage; S_2, a subhorizontal crenulation cleavage, sporadically developed in metapelites; and S_3, a moderately to steeply southeast to east-southeast dipping crenulation cleavage, pervasive in metapelites and axial planar to north-northeast to northeast plunging Z-folds (F_3). S_1 is a moderate to strong foliation in volcanic rocks, gabbro and leucogabbro. Ductile strain increases towards the base of the succession and it is here that S_1, combined with mylonitic fabrics, is particularly intense. F_3 folds range from centimetre-scale folds, typical of the metasediments, to broad flexures and 100-500 m amplitude open folds deforming the southern supracrustal-granite contact. The structures are particularly well developed in the mafic schists at the base of the succession where continued northwest-southeast shortening is expressed by tight, centimetre- to metre-scale symmetrical folds in the limbs of larger Z-folds. Shears and minor faults generally trend either north-northeasterly or easterly and have predominantly sinistral and dextral displacements, respectively. Most post-date granite emplacement.

Metamorphic grade varies from greenschist facies in metasediments at the eastern end of Camsell Lake to amphibolite facies in supracrustals, gabbro and leucogabbro

bordering the granite batholiths. Isograd traces, separating three metamorphic mineral zones (biotite, cordierite + andalusite, sillimanite), define a pattern which suggests that regional metamorphism coincided with the emplacement of the batholiths. Porphyroblastesis was pre-D_3 and syn- to post-D_1, in accordance with batholith emplacement.

Concentrations of sulphide minerals are found in several forms. Blebs and fine-grained disseminations of magmatic sulphides; pyrrhotite, pentlandite, pyrite and chalcopyrite, are common features in gabbro and leucogabbro. Extensive sulphide mineralization is marked by a 30-km-long band of narrow (<5 m wide), discontinuous gossans extending from Camsell Lake to the eastern end of the CLB. Most are stratiform concentrations of pyrrhotite and minor pyrite and chalcopyrite, typically disseminated and rarely as massive seams. Some of the sulphide zones south of Camsell Lake contain sphalerite and galena as well as pyrrhotite and chalcopyrite and have been the focus of base metal exploration. The remainder comprise minor concentrations of chalcopyrite, pyrrhotite, magnetite, sphalerite, pyrite and arsenopyrite associated with narrow quartz and quartz-carbonate veins. Most of these veins invade north-northeasterly trending faults and shears and bedding-parallel fractures. At the southwestern end of Camsell Lake, minor occurrences of chalcopyrite, pyrrhotite and pyrite are associated with areas of quartz-carbonate veining and carbonate alteration immediately below the volcanic-sedimentary contact.

The most significant assay result from the sampling program came from a quartz-veined gabbro. This sample, collected from a gossan in the centre of the CLB, yielded 15.2% Ni, 1.9 g/t Au (0.056 oz/t Au), 25.4 g/t Ag (0.741 oz/t Ag), and 3750 ppm Co. The gossan is subparallel to bedding, 1-2 m thick and at least 80 m long. The gabbro is characterized by massive, net-textured pentlandite, pyrrhotite and chalcopyrite, and the narrow quartz veins are fringed by massive arsenopyrite and disseminated galena. The arsenopyite and galena is reflected by anomalous arsenic (27.5%) and lead (665 ppm) in the assay.

Most of the mineral exploration in the Camsell Lake area has been directed towards copper and zinc. The gold potential of the various sulphide zones, particularly those containing arsenopyite, remains virtually untested. As well, the nickel and PGE potential of the sulphide-bearing gabbro and leucogabbro should not be overlooked.

LATE QUATERNARY HISTORY OF THE HEPBURN ISLAND (76 M) MAP SHEET

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The Hepburn Island map area was last glaciated during the Late Wisconsin by Laurentide Ice that flowed west, northwest and north across the map area. Glacial striae, grooves and other ice flow directional indicators show that, on a local scale, flow was topographically controlled during the initial and latter stages of glaciation. Blake (1963) describes associated regional glacial features in the surrounding map areas which indicate a regional flow towards the northwest.

Associated glacial deposits consist predominantly of a till veneer in the southern half of the map area, forming a thin and discontinuous diamicton cover over bedrock. Thicker accumulations of drift, representing a till blanket, also occur as isolated patches forming small till plains in the south-central regions. The marine transgression along the coast was simultaneous with ice retreat towards the south. In this glaciomarine environment, the deposition of well developed ridges of till, notably in the Wentzel River valley, took place. These ridge segments are transverse to ice flow and are interpreted as DeGeer moraines delineating former ice front positions. Similar features have been found a few kilometres to the west (Kerr, in Jackson *et al.*, 1986).

A major complex of eskers and kames of glaciofluvial origin occupies the east-west trending James River valley. Large kames terraces, some attaining 70 m in thickness, are confined to this corridor. Smaller and shorter eskers ridges and outwash plains north and south of the James River have a general northwest-southeast orientation. All of these features are the result of glacial meltwater activity. During deglaciation, small ice marginal proglacial lakes also developed. These were confined to the James River valley and to the valley of a northern tributary, and resulted from the ponding of meltwater between stagnating ice masses. The distribution of ice contact glaciolacustrine deltas indicates that lake level was at approximately 290 m a.s.l. and that the lakes did not exceed more than a few square kilometres in area. Fine grained lacustrine sediments are rarely encountered, attesting to the ephemeral nature of these glacial lakes.

Several glaciomarine deltas are found in the northern areas of the map sheet, ranging from 190 m to 205 m in elevation. The uppermost deltas at 205 m a.s.l. represent the marine limit, the elevation up to which the postglacial sea covered the isostatically depressed coastal lowlands. The land above 205 m a.s.l. south of this limit was not inundated by the sea. The 205 m a.s.l. limit for marine deposits is comparable to that found in the Kennarctic River valley by Bruneau (1984), as well as that reported by Blake (1963) for the Bathurst Inlet area. During the period of marine inundation, marine silt and clay were deposited up to an elevation of about 200 m a.s.l. The greatest and most extensive accumulations took place along the coastal lowlands in the Tree River, Kennarctic River and Wentzel River valleys. Coarsening upward sequences, from clay to sand and gravel, are exposed in stratigraphic sections near the mouths of several rivers, and record a progressive drop in sea level. Estuarine sediments now occupy much of the once-submerged coastal valleys. With the gradual isostatic uplift of the land, successive marine shorelines were constructed and now form raised beaches; although they are most commonly found along the present-day coastline below 60 m a.s.l., they are also present further inland up to an elevation of 190 m a.s.l. As newly-emerged land became exposed, the erosion and reworking of these marine sediments by streams and rivers quickly followed. Gravel, cobble and boulder lag deposits, present in many stream beds, are characterized by seasonal flooding and reflect the abundance of cobbles in till found south of the marine limit.

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CONTRIBUTIONS TO THE CANADA-NWT GEOSCIENCE INITIATIVE (1991-1996) BY THE MINERAL RESOURCES DIVISION, GEOLOGICAL SURVEY OF CANADA; AN OVERVIEW

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The Mineral Resources Division (MRD), Geological Survey of Canada (GSC), is manager of six Geoscience Initiative projects with a combined 1991-1996 budget of $705,000. The goals of all projects are to increase the metallogenic database in areas of known mineral potential, to help identify areas with high potential for the occurrence of mines, and to provide exploration companies with guidelines that are useful in their search for new ores.

Of the six projects carried by MRD, two are NWT-wide endeavours: 1) development of an up-to-date, comprehensive and accurate mineral resources map for the NWT, as well as a computer database of geological information that will be accessible to the public, and, 2) systematic documentation of the critical features of iron-formation-hosted gold deposits and occurrences (both stratiform Lupin-like and non-stratiform types).

The four other studies are focused within specific areas and include: 1) metallogeny of the southern Great Bear magmatic zone which contains polymetallic mineral deposits similar to the giant Olympic Dam Cu-U-Au-REE iron oxide mine in South Australia; 2) comparative mineral deposit geology of the High Lake and Courageous Lake greenstone belts, Slave Province; 3) metallogeny of the Archean greenstone belts and infolded Early Proterozoic cratonic sequences, Churchill Province, and 4) redbed Cu-Ag-Co in central Keewatin.

The Mineral Resources Division will also receive funding to provide a metallogenic contribution to the Minto Inlier project managed by Continental Geoscience Division of the GSC.

In an effort to promote the successful and timely delivery of products, linkages among the above-mentioned projects have been established, not only with other Geoscience Initiative projects managed by the GSC and the Mineral Initiatives Office (GNWT and DIAND), but also with A-base projects of the GSC and DIAND, including the Slave NATMAP project.

EXPLORATION METHODS FOR KIMBERLITE-HOSTED DIAMOND DEPOSITS IN THE NWT

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Economic kimberlite-hosted diamond deposits are found in stable Archean terrains older than 2.5 Ga ('Clifford-Sinitsyn Rule'; Janse, 1991). As such, vast tracts of land in the NWT (Churchill and Slave Provinces) are suitable areas in which to find kimberlites. Discovery of the Fort à la Corne kimberlites (70 pipes), which intrude a 3.1 Ga (Sm-Nd model age; Collerson *et al.*, 1989) Archean crustal block of the Trans-Hudson Orogen, Saskatchewan provides new incentive for kimberlite exploration in the NWT. Kimberlite-derived ultramafic xenoliths from the diamond stability field at Batty Bay, Somerset Island, additionally provides impetus for exploration.

One of the preferred exploration methods for locating kimberlite is the use of indicator minerals recovered from till and soil samples. However, in the NWT, application of this exploration method is problematic due to the effects of widespread regional glacial events, complicated by 'local' ice movements oblique to the regional flow pattern. Therefore, successful exploration should use a combination of techniques, based on type of country rock, overburden and climate.

The presentation will review application of indicator mineral sampling (heavy mineral separates from stream sediment, soil and till sampling), geophysical surveys (magnetic, gravity, electrical and radiometric) and remote sensing (LANDSAT, aerial photography) to kimberlite exploration. In the past 30 years, the most significant kimberlite discoveries (e.g. Siberia, Botswana, Western Australia) have been made using a combined exploration approach involving geophysical surveys.

A brief guide to the identification and discrimination of kimberlite from other petrographically similar, but unprospective rock types (e.g. olivine melilitite, alnoite) will be presented. Examples of various kimberlite morphologies (crater-, diatreme- and hypabyssal-facies rocks) and petrographic textures, as well as the use of a macrocryst mineral (garnets, spinel) chemistry to predict diamond potential for kimberlites will be discussed.

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ERUPTIVE HISTORY AND SEQUENCES OF THE ARCHEAN BACK RIVER STRATOVOLCANO, SLAVE PROVINCE, NWT

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The Back River volcanic complex (of the Back Group, Yellowknife Supergroup) is a ca. 2.7 Ga stratovolano which lies about 480 km northeast of Yellowknife, N.W.T. Four volcano-sedimentary sequences define the gross stratigraphy and represent the major episodes of volcanism, construction and erosion of this Archean stratovolcano: they are informally referred to herein as the Innerring sequence, Thlewycho sequence, Boucher-Regan sequence and the Keish sequence.

Dacitic to andesitic flows of the Innerring sequence represent the upper part of an ancestral volcano.

The Thlewycho sequence documents the main constructional phase of the stratovolcano. The eruptive sequence varied from 5 cycles of voluminous submarine to subaerial lava effusions interrupted by extensive volcaniclastic deposits on the present northern flanks, to rapid effusion of about 30 subaerial lava flows on the eastern side. The volcaniclastic debris (containing abundant rhyolite clasts) near the base of the northern succession suggests erosion from felsic parts of the ancestral volcano.

The Boucher-Regan sequence, in the northern and northwestern parts of the area, record the only major effusion of basaltic pillow lava. Andesitic effusions (probably from subaqueous fissures) followed the basaltic eruptions and eventually coalesced to central eruptions forming overlapping piles topped by intermediate to felsic tuffs and late-stage emergent felsic lava domes.

The Keish sequence is a clastic fan recording erosion of the volcanic pile on its western side.

Tuffs, rhyolite turbidites and debris flows within metasediments of the Beechy Lake Group indicate that the eroding volcano was still emergent and active while turbidites were being deposited in the immediately adjacent sea.

Sulphidic iron-rich mudstone/siltstone sequences and banded chert-, magnetite-, sulphide-, siderite iron-formations mark the close of each major volcanic cycle. Stromatolites preserved in carbonate along the shallow margins of the volcano record that life flourished for brief instances during the waning stages of this Archean stratovolcano.

The domal form of the southern part of the volcanic complex appears to represent a regional-scale, northwest-oriented, refolded second-generation structure. During D_2 regional shortening, shear strain partitioned along the boundary of the complex. The mylonitic fabrics suggest that the southern half of the volcanic complex has behaved as a large competent mass within a ductile matrix (Beechy Lake turbidites): the original form of the stratovolcano may have influenced the present geometry. The metaturbidites, therefore, may be para-authochtonous with respect to the volcanic complex.

ECONOMIC ASPECTS OF QUATERNARY STUDIES IN THE SOUTH GREAT SLAVE REGION (85 A,B,C&H)

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Quaternary investigations, including surficial mapping (1:250 000), of the region south of Great Slave Lake has been ongoing since 1989. The mapping area straddles two major physiographic regions. The Kazan Region (of the Canadian Shield), underlain by Precambrian igneous, metasedimentary and metavolcanic bedrock of the western Churchill Province and East Arm Subprovince, forms a generally low plateau with local relief of about 60 m. The Interior Plains, underlain dominantly by gently-dipping Paleozoic sedimentary strata, forms a lowland of nominal relief except in the SW corner of the mapping area, where the Cameron Hills (Cretaceous shales) rise abruptly 500 m above the adjacent plain.

The mapping region lies well within the Late Wisconsinan limit of the Laurentide Ice sheet. Drift thickness, which ranges from <1 m over much of the Shield to >300 m in the Cameron Hills, reflects both lithologic and topographic controls on ice dynamics. Till and lacustrine deposits are the dominant surficial materials. The glacial stratigraphy is generally simple, with only a single till sheet present in most exposures. The predominant ice flow direction during the last glaciation was southwestward. Local deglaciation began about 11 ka. Ice retreated rapidly across the Great Slave Lake basin by calving into glacial Lake McConnell, which occupied the isostatically depressed basin peripheral to the ice sheet. By 10 ka this vast lake covered most of the map area, and as a result there is a discontinuous blanket of lacustrine sediment below 300 m a.s.l. Regression from Lake McConnell to the present configuration of Great Slave Lake was largely a result of differential glacioisostatic tilting.

Former glacier dynamics (the style of ice advance and retreat), as well as glacioisostatically-controlled changes in surface drainage have influenced many aspects of modern economic activity. These include: i) construction (aggregate sources, engineering properties, and the distribution of permafrost); ii) petroleum exploration (seismic stratigraphy in areas of extreme drift thickness); and iii) base metal exploration (drift prospecting techniques). For example, coarse aggregate of the quality needed for construction is rare across much of the area as a result of the rapid glacier retreat associated with a calving front. The most important source of granular material in this region is beach gravel, deposited along the former margins of Lake McConnell and its regressive phases. These deposits are generally <3 m thick and of variable composition, ranging from >50% Shield material where till served as the source material to 100% Devonian carbonates where waves were able to erode bedrock outcrop directly.

The regional geologic setting and simple glacial stratigraphy make this an ideal location for the application of drift prospecting techniques. The baseline data obtained from analysis of 280 sediment samples for their trace element composition and carbonate content (<4 um fraction) can be used as a basis for detailed prospecting work in the area. Results show that a prominent anomaly noted is associated with the Pine Point lead-zinc deposits. Trace element levels are often lower in the upper compared to the lower parts of till exposures, and are uniformly low in surface lacustrine deposits. Hence use of drift prospecting techniques here, as

elsewhere, is dependant upon an understanding of the regional Quaternary history and sound stratigraphic interpretation.

MAFIC DYKES IN THE CHAN FORMATION, YELLOWKNIFE GREENSTONE BELT: A PROGRESS REPORT.

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This project, initiated in the field season of 1991, is designed to study the field relationships and chemical affinities of mafic dykes, gabbroic anorthositic bodies, and mafic volcanic rocks in the Chan Formation at the base of the Kam Group in the Yellowknife Greenstone Belt. The purpose of this work is to assess whether these rocks originated in an intracontinental rift or oceanic basin environment.

The detailed mapping near Oro Lake, undertaken during July and August of this year, compiled together with previous mapping in the area, gives a first impression of the temporal and spatial relationships amongst the various rock types as well as their relative abundance. Several different sets of mafic dykes have been distinguished in the field based on weathering color, mineralogy, phenocryst content, and cross-cutting relationships. In addition to dykes, there are numerous mafic sills which may be contemporaneous with some of the dyke sets. Several sets of felsic dykes are probably related to granitoid intrusions to the north and west (Anton Granite, Western Granodiorite and Duckfish Granite). The possibility that some of the felsic dykes may be plagiogranites, related to early mafic intrusive rocks, will be investigated. Several large diabase dykes of the MacKenzie Swarm are also present.

A significant feature of the Chan Formation is the presence of a sill-like anorthositic body, best exposed at Ano Lake, south of Oro Lake. This anorthositic body shows some compositional variation and may be genetically related to the earliest gabbroic rocks in the area. The lateral extent of this sill is considerably greater than previously mapped, as anorthositic rocks have been identified as far east as Banting Lake.

Petrographic work on samples collected during the past field season is in progress and may help to consolidate the distinctions made in the field between the various intrusive units. Emphasis is placed on identifying minerals suitable for absolute age determinations.

Future work on this project, which will include another season of field work, will extend the area of detailed mapping and concentrate on a comprehensive geochemical study involving both major oxide and an extensive array of trace element analyses. The trace element chemistry, in particular, should help to determine possible chemical affinities with rocks formed in modern tectonic environments and assess whether the mafic rocks of the Chan Formation have been contaminated by continental material.

* work funded by DIAND, NWT.

HEPBURN ISLAND (76M) NATMAP PROJECT, SLAVE PROVINCE, NWT

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The Hepburn Island (76 M) component of the National Mapping Program (NATMAP) in the Slave Province was initiated in 1991 with reconnaissance bedrock investigations by members of the GSC, DIAND and the GNWT. The objectives of the Hepburn Island project are to further evaluate complex stratigraphic-structural-metamorphic relations, determine the significance of the numerous faults in the area, subdivide and study the petrogenesis of the plutonic rocks, and conduct geochemical and isotopic studies. This work will provide new perspectives on the mineralization and tectonic evolution of this part of the province. The aim of this year's reconnaissance was to establish scientific and logistical strategies and priorities for the three participating agencies.

Reconnaissance investigations, directed by the compilation map of Jackson (1989), established several high-priority interests. The following conclusions were drawn from this summer's work:

1) Stratigraphic correlations in the High Lake and Anialik River volcanic belts are suspect, as both belts have undergone shearing, faulting and numerous cleavage-forming events. The effects of deformation on the distribution and grade of base- and precious- metal showings in the belts are not well understood.

2) Field observations of granitoid rocks, supported by regional magnetic anomaly maps, indicate a wide range of compositions and textures that can probably be subdivided into distinct plutonic suites. Careful mapping of the granitoids may reveal more syn-volcanic plutons similar to the Anialik River igneous complex, which contains several shear-zone-hosted gold deposits.

3) Several sets of structures have been recognized in different parts of the map area, but correlation of these structures between different map units has not yet been established. For example, metaturbidites east of the High Lake volcanic belt contain at least two foliations and one fold set, but only one bedding-parallel foliation has been documented in the adjacent volcanic belt, and the age of this foliation relative to the structures in the metaturbidites is unknown. Likewise, a dominant bedding-parallel foliation characterizes the Anialik River volcanic belt east and west of the Anialik River igneous complex. South of the complex, this foliation can be resolved into three foliations, although none of these have yet been unequivocally traced into the adjacent Anialik River igneous complex.

4) The Anialik River igneous complex, which sits structurally *below* the Anialik River volcanic belt, cores the *lowest* (metamorphic) grade part of the belt. This suggests a complex

metamorphic configuration, possibly unique in the Slave Province.

5) A distinct unit of tonalite to monzogranite orthogneiss that is extensively recrystallized and structurally convoluted was recognized on the coast about 5 km west of the Anialik River volcanic belt. This rock has a U-Pb zircon age of 1987 ± 16 Ma, as indicated by the linear array of analyses near the lower end of a chord. The upper end intercepts concordia at ca. 4.0 Ga, suggesting that the inherited zircons comprise a homogeneous population. Given that the areal extent and contact relationships of this rock are unknown, the possibility exists that the lower intercept represents an age of metamorphism. Nevertheless, this date points to the presence of an Early Proterozoic event in the northwestern part of the Slave Province.

References

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RECONNAISSANCE OF THE STRATIGRAPHY AND STRUCTURE OF THE BASLER LAKE AREA, SOUTHERN WOPMAY OROGEN, NWT

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In the Basler Lake area (85 O/NW, 85 N/NE, 86 C/SE, and 86 B/SW) of southern Wopmay Orogen (NWT), Early Proterozoic sedimentary rocks of the Snare Group are exposed in a north-trending outcrop belt, bordered on the east and west by Archean granitic rocks and sedimentary rocks of the Yellowknife Supergroup. The granitic rocks intrude the Yellowknife rocks, but are basement to the Snare Group.

The Snare Group consists of a lower siliciclastic sequence and an upper carbonate sequence separated by a major sequence boundary. The siliciclastic sequence is composed of a basal trough-cross-stratified sandstone unit, a middle mixed siliciclastic and carbonate unit, and an upper wavy and planer-laminated siliciclastic unit. Siliciclastic rocks of the Snare Group are interpreted as dominantly tidal in origin. Episodic and ultimately prolonged subaerial exposure led to early carbonate cementation and the development of a karstic breccia at the top of the sequence. The siliciclastic sequence was deposited on a shoaling-upward, shallow marine shoreline. The overlying carbonate rocks, consisting of a basal rhythmite unit, interpreted as a deeper-water slope deposit, a middle stromatolitic reef unit, and an upper epitidal, "contiguously" laminated unit, define a shoaling-upward slope and shelf sequence.

Long-wavelength basement-involved folds and superimposed shorter-wavelength folds within the Snare Group siliciclastic rocks accommodated shortening in the Basler Lake area. The structure of the northern end of Basler Lake is dominated by a single tightly folded, basement syncline. A wrench fault splits the fold. From east to west across the wrench fault, the style of folding in the cover rocks changes abruptly from open to isoclinal. At the southern end of Basler Lake, the basement folds are more open than in the north, producing a gently undulatory basement-cover contact. The westward change from open to isoclinal folds in the cover rocks is more gradual than in the north.

The change in structural style from south to north in the Basler Lake area is coincident with the abrupt northward pinch-out of the 800-metre-thick Snare Group siliciclastic sequence. This lateral change in lithology may be the result of structural cut-out by a normal fault or stratigraphic on-lap and sediment by-pass of a topographic high.

GEOLOGY OF THE FAT LAKE MAP SHEET: PRELIMINARY RESULTS (75 M/5 AND PART OF 75 M/4)

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Rock types and structures were mapped at a scale of 1:30 000 in the Fat Lake portion (75 M/5) of the Camsell Lake supracrustal belt during the 1991 field season. Previous published geological information is limited to a regional 1 inch to 4 mile lithological map (Henderson, J.F., 1944; MacKay Lake, Geological Survey of Canada Map 738A).

The Camsell Lake belt trends northeast, with a prominent protrusion southward into the Rolfe Lake granitoid terrane (75 M/4) and an opposing protrusion northward. Moderately to steeply inclined volcanic rocks face away from bordering granitoid plutons towards younger greywacke-mudstones. The volcanic rocks dominantly consist of pillowed or massive mafic flows. Minor intermediate and felsic units lie mainly in upper parts of the succession; some are interbedded with the overlying metasedimentary rocks. Discontinuous bodies of anorthosite, gabbro or diorite interspersed within the volcanic rocks may be consanguineous.

The southern protrusion from the belt marks a major steep-limbed, isoclinal syncline, the hinge of which is obscure. The axial surface trace extends 20 km north-south within a core of metasedimentary rocks that vary from greenschist grade along the central portion to amphibolite grade further north and south where syn-kinematic cordierite and andalusite porphyroblasts are common.

A widespread S1 foliation is defined by flattened pillows and fragments in the metavolcanic rocks and by the alignment of biotite and muscovite, which in the metasedimentary rocks generally parallel bedding. Whereas S1 and bedding curve gradually from north-south along the eastern limb of the major syncline to northeast along the easterly extension of the belt, structures on the western limb and along the protrusion northward form angular corners with structures along the westerly extension. S1 and bedding in the metasedimentary rocks striking uniformly in one direction abut against or are interspersed with similar structures at high angles. Time relations between the directional sets are not apparent.

A high strain zone marked by strongly foliated and silicified mafic to felsic metavolcanic rocks parallels the northern margin of the western extension of the Camsell Lake belt.

Later generations of sporadically developed foliations include an S2 crenulation cleavage lying oblique to S1. S2 is locally axial planar to steeply plunging mesoscopic tight folds.

intersection, crenulation and stretch lineations are generally steep. Exceptions include a sporadic late (L3) shallow plunging crenulation lineation and associated subhorizontal S3 cleavage in the metasedimentary rocks.

With the exception of some phases bordering the supracrustal rocks, granitoid plutons are mainly weakly foliated or lack obvious deformational fabrics. Thus for the most part, emplacement appears to have been at a late stage or after regional deformation. West of the major syncline, a biotite ± hornblende granitoid complex includes strongly foliated migmatite near the western extension of the Camsell Lake belt. Moderately foliated agmatites lie along the western north-south limb of the syncline. Elsewhere within the western complex a late-stage, locally developed foliation strikes north northeast. East of the syncline, biotite ± hornblende granite is highly foliated against flattened metavolcanic rocks, whereas weak foliations prevail along the northern margins of the belt within both a northeastern K-feldspar porphyritic biotite granite and a western biotite-muscovite granite which is crossed by garnetiferous pegmatites.

Molybdenite-bearing pegmatite is associated with the southeastern biotite ± hornblende granite.

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THE RELATIONSHIP OF GOLD MINERALIZATION TO GRANITE INTRUSIONS, NERCO CON MINE, YELLOWKNIFE, NWT

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The NERCO-Con Mine site (85 J/8) provides an exceptional case study for elucidating the relationship of granite intrusions to shear-hosted gold mineralization. Numerous intrusions and associated breccia zones occur within a hornfelsed corridor projecting outwards from the Western Plutonic Complex through the immediate mine site. Eastward, these intrusive breccia centres are deep-level granite-matrixed, intermediate-level quartz-feldspar porphyry injected and high-level hydrothermally altered. Detailed work on the Negus Centre, exposed in the central mine workings, best illustrates the granite-gold relationship.

Three stages of breccia-hosted alteration can be discerned:

1: Quartz-epidote ± K feldspar ± grossular garnet pegmatite pockets coincidental with the emplacement of quartz-feldspar porphyry intrusions at peak metamorphic conditions. Amphibolite breccia matrix hosts amphiboles with actinolitic cores (Al_2O_3=3%) and hornblende rims (Al_2O_3=14%) coexisting with labradoritic plagioclase (An_{50-60}). Near intrusions and pocket pegmatites amphiboles are homogeneous magnesia-hornblendes with 8.3% Al_2O_3. Stage 1 has no gold enrichment.

2: Quartz-calcite-Mg chlorite-prehnite-phlogopite-pyrrhotite-chalcopyrite alteration associated with jointing. Chlorite compositions increase from 17.0% to 22.5% MgO into the joints. Stage 2 has low gold averaging 33 ppb.

3: Pervasive sericite-ankerite-pyrite-arsenopyrite alteration with quartz veining. White micas are 95% end-member muscovite. Gold in stage 3 averages 172 ppb.

U/Pb zircon dating (J. Mortensen, GSC) of the Deep Pud stock is the oldest dated member of the Defeat Plutonic Suite (2634 Ma). The Negus plug is an evolved Mo:Au bearing tronjhemitic quartz-feldspar porphyry enriched in the LREE. The upper part is typified by highly porphyritic phases, micrographic textures, and miarolitic cavities, and exhibits pervasive sericite-calcite-ankerite-pyrite alteration. Similar to stage 3, white micas are 95% end-member muscovite but are zoned with FeO (3.0%), MgO (4.0%), TiO_2 (.65%) and BaO (0.8%) rich cores relative to rims. Gold concentrations generally increase with intensity of alteration ranging from 5 ppb in fresh granodiorite, 11 ppb in unaltered tronjhemite, to >97 ppb in altered quartz-feldspar porphyries at the Negus Centre. Maximum concentrations of 3 g/t Au (0.088 oz/ton) are associated with quartz veins. Stage 3 alteration is similar to the selvage development on gold-bearing quartz veins within producing shear zones.

A model is proposed whereby apophyses off the Western Plutonic Complex intruded the regional metamorphic aureole and underwent the same cooling history. The absence of chills on the porphyries indicate high-temperature wallrocks at the time of intrusion. In contrast to a classic porphyry setting where intrusions into high-level cold environments rapidly crystallize on separation of an aqueous phase, injections into metamorphic settings "stew" in ambient prograde metamorphic fluids over a long period of time. In terms of metal concentration, molybdenite is a high-temperature magmatic phase while gold is a low-temperature hydrothermal phase.

Gold-bearing shear zones clearly postdate granite emplacement. There is no reason why granite subject to the same cooling history as the metamorphosed volcanics should not also host gold. At the mine site shear zones crosscut the Pud stocks, numerous porphyry dykes in all levels of the old Negus shaft and the granodiorite-volcanic contact at Kam Lake. Shears deep within the granite, such as at the Rod claims, have been past producers. Other prospects within granite include the Golden Marlin claims at the southern extremity of the belt. Recent NERCO exploration results showing indications for gold within the Western Granodiorite include: 1-to 2-m-wide silicified chlorite-calcite-pyrite shear zones (24 ppb Au); 1-m-wide open-space quartz-dolomite-sphalerite-galena-pyrite-fluorite veins (41 ppb Au); and 10-m-wide or wider quartz-molybdenum-pyrite stockwork systems averaging 163 ppb Au. Given the characteristics of gold-bearing shears in granite with respect to their volcanic counterparts, ie. very narrow structures, subtle bleaching and tight cut-off grades; such deposits could be easily missed. It is possible that the Yellowknife-area granites could host deposits similar to those in the LaRonge Gold Belt of Northern Saskatchewan, where granite-hosted deposits are characterized by high gold grades (10 to 17 g/t) and produce between 1500-3000 kg (50 to 100 thousand ounces) of gold.

THE 1991 - 1996 GEOSCIENCE INITIATIVE: RENEWED CANADA-NWT COLLABORATION

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During the past year negotiations between Canada and the NWT for a new Economic Development Agreement (EDA)

were successfully completed. In July 1991, as part of the new 5-year EDA, DIAND and the GNWT signed a Cooperative Agreement supporting numerous Economic Development Initiatives; $8.2 million is to be devoted to four Mineral Initiatives. The 1991 - 1996 Geoscience Initiative will be implemented by the Department of Energy, Mines and Petroleum Resources (EM&PR, GNWT). EM&PR will deliver 60% of the $7.5 million budget; the Geological Survey of Canada (GSC) will deliver the remainder.

Consultation between EM&PR, DIAND-Geology, GSC and the mineral industry resulted in development of a selection process for projects to be funded under the Geoscience Initiative. The government agencies prepared a comprehensive list of projects which reflected recommendations from the Mineral Development Agreement (MDA) evaluation, discussions with industry, and perceived mineral potential, status of mapping, and industry interest/activity in an area. The preliminary list was presented to industry through the Chamber of Mines for comments and preference rating. The survey results were paramount in development of a final list of projects, as was collaboration between the three agencies. The final package was required to meet financial constraints and regional targets as set out in the EDA.

The Geoscience Initiative comprises fifteen regional mapping projects, six mineral deposit studies, and two data compilation projects. Of these, the EM&PR/DIAND Mineral Initiatives Office (GNWT) will deliver eight mapping projects, three of which are underway, and one database project.

GEOLOGICAL INSIGHTS FROM THE SQUALUS LAKE AREA (85 P), SLAVE STRUCTURAL PROVINCE

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The Squalus Lake area, centred approximately 160 km north-northeast of Yellowknife in the Slave Structural Province, is underlain by an extensive granitic terrane containing remnants of high-grade supracrustal and gneissic rocks. The complexity of structural, metamorphic and intrusive relationships is not evident from previous 1:253 440 mapping, which suggested metamorphosed equivalents of the Yellowknife Supergroup mantle the northern margin of a granitic batholith and join the Beaulieu River and Cameron River volcanic belts.

Supracrustal rocks are predominantly dark-grey amphibolite schist and gneiss of unspecified protolith. A zone of recognizable mafic pillowed flows extends southward from Phoenix Lake through Thetis Lake (NTS 85 P/11,14). Elsewhere, the proportion of quartz and biotite was used during 1:50 000 mapping to distinguish possible meta-sedimentary and metavolcanic rocks. Sedimentary and mineralogical features typical of turbiditic domains were not detected. Grain size, colour index, mineral segregation and leucosome development are variable at all scales. The supracrustal rocks are preserved as amoeboid and linear zones within multiphase granitoids.

The most abundant lithology is medium-grained to porphyritic two-mica granite, assumed to be contiguous with the Morose Granite to the south. Although generally massive and homogeneous, the local preferential alignment of microcline phenocrysts and mica defines a weak to moderate fabric. Gneissic granitoids, migmatite, orthogneiss and possible paragneiss are spatially associated with the amphibolite zones. Magnetite is variably developed in massive to gneissic granitoids and contributes to the complex aeromagnetic patterns of the map area. Polydeformed tonalitic gneiss northeast of Sharples Lake is the most probable basement in the study area.

Two episodes of regional deformation are evident in the supracrustal rocks; the complexity of folding in some gneissic rocks suggests a more-protracted strain history. In the Thetis Lake area, mafic flows are strongly flattened and segregated into a layered or laminated fabric (S_1). Subsequent deformation has folded the regional layering into tight to isoclinal structures with local development of intense crenulation cleavage (S_2). In other areas, the variation in S_1 orientations suggests a similar folding history. The Morose Granite transects, and hence post-dates, the regional fold structures.

A complex system of late faults complicates the regional geology. The youngest fault in the map area, a north-northeast trending structure along the eastern margin of Sharples Lake, is traceable on high-altitude images for approximately 100 km. Regional patterns suggest a 5 to 10 km dextral component of displacement, although distinctive offset markers were not recognized in the study area. Similarly oriented dextral ductile faults abut a northeasterly trending fault extending from Phoenix Lake. The conflicting cross-cutting relationships suggest approximate contemporaneity of fault movements. East-northeast trending Proterozoic dykes have not been traced across the fault zones.

Despite the presence of numerous and extensive gossans, none sampled contained economic concentrations of base or precious metals. A maximum of 136 ppb Au was detected from assays of 71 sulphide-bearing samples. Base metals, represented primarily by Cu and Zn, attained a combined maximum of 1.7%. All significant sulphide zones encountered in this study, most bearing pyrite and pyrrhotite, are within the narrow supracrustal domains. Mapping in the Squalus Lake area has demonstrated the greater distribution of supracrustal rocks than previously reported. Hence, the area probably has greater exploration potential than previously thought. Further prospecting and sampling may prove beneficial.

GEOLOGY AND STRUCTURE OF THE MELIADINE LAKE-GIBSON LAKE REGION, DISTRICT OF KEEWATIN, N.W.T.

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Polydeformed and regionally metamorphosed Archean supracrustal and granitoid rocks are exposed in the Meliadine Lake-Gibson Lake region (NTS 55 J,K,N,O) west of Hudson Bay. The Meliadine Lake area is underlain by an Archean (ca 2.63 Ga) metavolcanic-metasedimentary sequence, the Rankin Inlet Group. The sequence forms an F_1 homocline that is folded into a southeast-plunging F_2 syncline. Previous stratigraphic and structural studies identified pre-F_2 ductile thrusts within the sequence. Both deformation and greenschist-grade metamorphism are believed to be Archean. Along the north limb of a regional-scale F_2 syncline, adjacent

to one of the thrusts, three sets (F_a,F_b,F_c) of pre-F_2 mesoscopic folds are present in the turbidite-hosted, locally auriferous quartz-magnetite iron formation. A prograde assemblage of biotite + chlorite in silicate-rich layers of the iron formation is overprinted by random to weakly oriented intergrowths of fine-grained grunerite + hornblende + carbonate with pyrrhotite, and coarse hornblende ± biotite with arsenopyrite. The epigenetic gold mineralization appears to be structurally controlled by a widespread, northeast plunging, youngest set of pre-F_2 folds (F_c) with Z-asymmetry. The metamorphic textures suggest that gold mineralization is associated with local S, Ca and CO_2 metasomatism.

The Archean lithologies in the Gibson Lake area (NTS 55 N, east-half) are dominated by quartzo-feldspathic gneiss, migmatite, granitoid plutons, and to a lesser extent by pelitic schist, amphibolite, and garnetiferous, silicate iron formation. The iron formation appears to have a limited economic potential. Numerous discontinuous and folded high-strain zones, some of which contain tectonized remnants of anorthosite, gabbro, and mylonitized pegmatitic dykes, transect the migmatititic gneisses. Undeformed mafic and felsic intrusions of probable Early Proterozoic age occur throughout the region. At least four sets of folds and one event of amphibolite-grade regional metamorphism can be recognized, and the regional distribution of rock units is largely controlled by shallowly west-plunging, open, upright F_3 folds.

Previous structural, stratigraphic, thermobarometric, and geochronological studies to the east and northeast across an Archean and Proterozoic granite-greenstone-gneiss terrane outlined several crustal-scale ductile, high-strain zones that separate and expose different levels of crust. The tectonic juxtaposition of these crustal segments is believed to have occurred in the early Proterozoic prior to emplacement of 1.85 Ga fluorite granites. The results of recent mapping in the Meliadine Lake-Gibson Lake region are briefly discussed in the context of regional tectonic framework of the portion of the Churchill Structural Province west of Hudson Bay.

WINTER LAKE - LAC DE GRAS PROJECT: REGIONAL BEDROCK MAPPING IN THE CENTRAL SLAVE PROVINCE

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Located 250 km north of Yellowknife, the area to be mapped (10 800 km²) includes parts of three volcano-sedimentary domains (Point Lake-Contwoyto Lake, Yellowknife-Beaulieu River and Lac de Gras-Courageous Lake) that have produced most of the mineral wealth of the Slave Province. A reconnaissance this summer confirmed that an upgrade of regional bedrock and surficial mapping will be a major contribution to knowledge of the origin, evolution and economic potential of the Slave Province.

For example, expansion of the lithologic/stratigraphic column for the area has begun with discovery of low-grade, quartz-rich and pelitic metasedimentary rocks within the mafic volcanic belt at the south end of the Point Lake supracrustal domain, of mafic volcanic rocks within an area mapped as gneissic and massive granite, and of migmatitic/gneissic granitoid rocks that may be basement to the supracrustal sequence. The area of established economic potential has been increased by differentiation of supracrustal from granitoid components within gneissic and migmatitic metamorphic rocks. There is new structural evidence that some gneissic and migmatitic granitoid rocks are basement to the supracrustal sequence. The kilometre-scale interlayering of potential basement rocks, amphibolite gneiss and migmatitic metasedimentary rocks mapped near Lake Providence is attributed to thrusting during the main phase of deformation. Two large plutons surrounded by greenschist facies meta-greywacke and phyllite near Courageous Lake were found to be metamorphosed and variably-deformed tonalite-diorite\monzodiorite. Confirmation of the absence of mappable contact metamorphic aureoles indicates that the plutons were intruded into the sedimentary rocks before regional metamorphism and became detached from the associated aureole during main-phase deformation, or the "plutons" are basement to the supracrustal sequence.

Systematic regional mapping of bedrock and surficial deposits at 1:250 000 scale is planned for the next three summers. At the same time, 1:50 000 mapping of the Snare River volcanic belt and associated metasediments in the western half of the area and 1:12 000 mapping of the central part of the Courageous Lake volcanic belt will be completed under the auspices of the Geoscience Initiatives Program. The combination of special studies in the fields of geochronology, metallogeny, igneous petrology and isotopic tracers, paleomagnetism, and geophysics and bedrock mapping will help to solve problems derived from new mapping as well as contribute to resolution of some of the classic problems of Slave geology.

CONSTRAINTS ON METAMORPHISM IN THE TORP LAKE AREA, NORTHERN SLAVE STRUCTURAL PROVINCE (NTS 76 N/3,4,5,6,11)

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During 1989 and 1990, field work was completed for a metamorphic study of the Torp Lake area in conjunction with a 1988-90 MDA mapping project. General geology is discussed in Johnstone (1988, 1989, 1990). This report summarizes results of petrographic and thermobarometric studies.

Metamorphic grade ranges from sub-greenschist in the northeast to upper amphibolite in the south. Two mineral isograds were mapped in pelitic rocks: a cordierite isograd, based on the first appearance of cordierite, with or without andalusite, and a first-sillimanite isograd. Locally, a sillimanite-potassium feldspar isograd was mapped prior to migmatization (injection?).

Equilibria relating assemblages below and above mapped isograds were derived petrographically from textural relationships. The mineral assemblage below the cordierite isograd is chlorite + white mica + biotite + quartz + plagioclase. At the cordierite isograd, the following generalized equilibria are responsible for further production of biotite, and the first appearance of cordierite and andalusite:

chlorite + white mica ⇄ biotite
chlorite + white mica ⇄ biotite + andalusite + quartz
chlorite + white mica + quartz ⇄ biotite + andalusite + cordierite.

The first appearance of sillimanite occurs at the polymorphic transition of andalusite to sillimanite:

andalusite ⇄ sillimanite,

and subsequently by muscovite breakdown to sillimanite + potassium feldspar:

muscovite + quartz ⇄ sillimanite + potassium feldspar.

The northern half of the study area is underlain by low- and medium-grade rocks. Map-scale isoclinal folds (F_1) have no associated fabric. An S_2 fabric post-dates these folds, and is defined by quartz veins and a northwest-trending biotite foliation in 2610 Ma tonalite and 2604 Ma diorite (Johnstone and van Breemen, in prep). Minor folds (F_2) are associated with these fabrics. A regional fabric (S_3) is defined by a steeply-dipping northeast cleavage or mica-biotite foliation in greenschist-grade rocks, and a biotite-fibrolite foliation in amphibolite-grade rocks. Two fabrics may be recognized in low-grade pelitic rocks, and not observed in higher-grade equivalents: a sub-horizontal cleavage (S_4) and a steep-dipping, semi-penetrative north-striking cleavage (S_5). Both fabrics have no recognized associated folding.

Porphyroblast-matrix relationships differ temporally between the low-grade extreme of the cordierite zone and the sillimanite zone (20 km), in a manner suggesting the main heat source of the metamorphism was the syn- to post-thermal peak biotite ± hornblende granite in the high-grade area. The age of post-thermal peak muscovite-biotite granite in the area would be a useful constraint on the minimum age of metamorphism, however, low-uranium contents of zircons collected from this body have impeded dating attempts thus far (pers. comm., van Breemen, GSC).

The thermal peak of high temperature/low pressure metamorphism is during D_3, recognized by sillimanite folia (S_3-regional) and fibrolite in pressure shadows of relic andalusite porphyroblasts. However, in lower-grade rocks, biotite, cordierite and andalusite porphyroblasts post-date the S_3 (regional) and S_4 fabrics.

In the fine-grained matrix of lower greenschist rocks, S_3 and S_4 are expressed as slatey cleavage and spaced crenulation cleavage, respectively. The S_4 fabric concentrates white mica, and squeezes out quartz to either side of the crenulation cleavage. S_3 and S_4 traced into biotite porphyroblasts are defined by quartz-bleb inclusion trails. Where andalusite overgrows these fabrics, S_3 is a quartz-bleb inclusion trail, and solid andalusite defines S_4, in what is otherwise a poikiloblastic phase.

In middle amphibolite rocks, relict andalusite porphyroblasts preserve inclusion trails of S_2 in microlithons between S_3 (internal) in quartz blebs and, rarely, biotite. The S_3 fabric (external), is a biotite or biotite-fibrolite foliation which wraps around the porphyroblasts, indicating that andalusite growth ceased before the culmination of S_3.

Sporadic garnet-bearing assemblages inhibit wide application of common thermobarometers (ie. garnet-biotite, GASP). Iron-enriched bulk compositions yielded two garnet-bearing samples, from lower and upper sillimanite-muscovite zone pelitic rocks. Pressure-temperature calculations using garnet-plagioclase-sillimanite-quartz barometry and garnet-biotite thermometry and gave a pressure of 3.0-3.5 kbar and temperature of 450 C, and 4.0-4.5 kbar, 600-650 C, respectively.

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IN SUPPORT OF ARCTIC RESEARCH

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The Science Institute of the Northwest Territories was created by an Act of the Legislative Assembly in April of 1986. The Institute is an arms-length agency of the Territorial Government, managed by an appointed Board of Directors who report to the Legislative Assembly through a Minister.

Since its creation, the Science Institute has developed a number of programs to promote science and scientific research in the Northwest Territories. These programs are administered by five departments namely, the Scientific Services Directorate, the Scientific Licensing Service, the Education and Information Program, the Technology Development Program and the Industrial Research and Assistance Program.

The Scientific Services Directorate is responsible for the year round operation of three Research Centres located in Inuvik, Igloolik and Iqaluit (formerly Frobisher Bay). Of particular interest to university, government and industry researchers is the logistical support available at each Centre. This can include accommodation and office space, technical support, use of computers, drafting facilities, conference rooms, freezers, laboratories, library and reference materials, storage space for field equipment and radio support for field parties. Researchers conducting bona fide research and holding a Northwest Territories Science Licence, are not charged for support.

The Scientific Licensing Service is responsible for licensing research projects in the Northwest Territories (except wildlife and archaeological studies). Through the Science Administrator, communities likely to be affected by a proposed research project, are consulted. A Scientists Licence is issued to a researcher when the project meets the requirements of the "Scientists Act".

The Education and Information Program promotes science and

technology in the Northwest Territories. For example, the Institute supports regional Science Fairs and sponsors annual cross-cultural science camps.

The Technology Development Program's main focus is evaluation of energy alternatives and waste disposal methods in the Northwest Territories smaller communities.

The Industrial Research Assistance Program (IRAP) is a joint venture between the National Research Council and the Science Institute. This program provides technical and industrial support services to businesses in the Northwest Territories.

In this presentation, the programs of the Science Institute of the Northwest Territories will be briefly reviewed. The logistical support available to Arctic researchers through the Institute's Scientific Services Directorate will be highlighted.

APPLICATION AND RESULTS OF GEOPHYSICAL SURVEYS FOR UNCONFORMITY TYPE URANIUM DEPOSITS IN THE THELON BASIN, DISTRICT OF KEEWATIN, NWT (NTS 66 A/5)

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Urangesellschaft Canada Limited, PNC Exploration (Canada) Co. Ltd. and DAEWOO Corporation have been involved in a uranium exploration joint venture in the Thelon Basin, near Baker Lake, District of Keewatin, since 1986. (Sissons Schultz South project).

The project area is located south of the Kiggavik (formerly Lone Gull) uranium deposit, first discovered by UG in 1974. The geology and structural pattern of the general area are in many ways analogous to the Athabasca Basin in Saskatchewan.

Very poor outcrop conditions over most of the area have necessitated the use of various geophysical methods in the search for additional mineralization. The mineralization is embedded and surrounded by strong sericitic-illitic hydrothermal alteration zones which along with structural features respond well to geophysical surveys such as magnetics, resistivity, VLF and gravity.

A major breakthrough in the exploration approach was achieved in 1987 when an airborne resistivity system was successfully tested over known mineralized areas and subsequently was responsible for the discovery of two new orebodies.

Extensive computerization of the exploration surveys has considerably reduced field time needed to test anomalies and manipulate data.

A wealth of new geological data has resulted from the exploration work. While previous mineralization occurred only within sericitic-illitic altered rocks, very recent drilling has discovered high-grade mineralization in little to unaltered rocks at much greater depth than before. Host rocks for most of the mineralization are Aphebian metasediments and possibly Archaean metagneisses.

Apparent geological reserves within the two new orebodies discovered are close to 36 million kg (80 million pounds) with an average grade of around 0.5% U_3O_8. The best drill hole so far yielded 158 m with an average grade of 0.9% U_3O_8.

A large number of additional geophysical anomalies have been outlined in the area and wait to be drill tested.

RELATION OF DEFORMATION AND METAMORPHISM TO GOLD-BEARING IRON FORMATION AT PISTOL LAKE, NWT

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The Pistol Lake Area west of Bathurst Inlet (NTS 76 N/2) contains a gold showing associated with mixed ironstone of the Archean Hood River Belt. Host rocks are predominantly pelagic chemical and siliciclastic sediments. Gold in ironstone occurs with pyrite, pyrrhotite and arsenopyrite. Calc-silicate alteration haloes occur proximal to quartz veins. Rare chalcopyrite, galena and sphalerite have been reported. Mineralization is controlled by structure and composition.

The Pistol Lake Area is part of the Hood River Belt, which consists of Archean supracrustals and related granitoids. The supracrustals include sediments of both pelagic and volcanic arc affinities. Volcanics and related intrusions define an igneous complex in the central portion of the belt.

Supracrustals generally strike north-south, dip steeply west and young to the east. A dominant cleavage, S_2(?), strikes 25° clockwise of bedding with steep dips. Cleavage fans through the sequence. The transecting relationship between bedding and cleavage implies transpressive deformation. Locally, the structural geometry is cylindrical, as at Pistol Lake.

Metamorphic grade across 15 km of section is uniformly low-pressure, indicated by the presence of andalusite. This event overprints an earlier, high temperature, bedding parallel foliation. Local fibrous sillimanite is related to granitoid emplacement. The implication is that crustal-scale, tectonic transport produced the current geometry prior to the onset of low-grade metamorphism and transpression. The tectonic setting is believed to be an Archean accretionary prism.

Proterozoic events in the area include several generations of mafic igneous activity, deposition of the Goulburn Group to the east and brittle-ductile faulting. The latter, related to the collision of the Slave and Churchill provinces along the Thelon Tectonic Zone, has been an important control on the final geometry of the auriferous ironstone at Pistol Lake.

Field-based study of this area was aided by the acquisition of remotely sensed data by the Canada Centre for Remote Sensing. This, combined with elevation data and geology were used as a test-bed for the application of Geographic Information Systems in geology. The resulting product contains information on lithology and structure combined with enhancements and classifications using Landsat Thematic Mapper (TM), SPOT Multi-Spectral Scanner (MSS), Synthetic Aperture RADAR (SAR) and airborne magnetics.